COVER SHEET

Pacific Coast Groundfish Bycatch Management
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

Proposed Action: The Pacific Fishery Management Council and the National Marine Fisheries Service propose to establish the policies and program direction to minimize bycatch in the West Coast groundfish fisheries to the extent practicable, minimize the mortality of unavoidable bycatch, and ensure that bycatch is reported and monitored as required by law.

Type of Statement: Draft Environmental Impact Statement

Lead agency: NOAA Fisheries (National Marine Fisheries Service)

For Further Information Contact:

Mr. D. Robert Lohn
Regional Administrator
National Marine Fisheries Service Northwest Region
7600 Sand Point Way
Seattle, WA 98115-0070
Telephone: (206) 526-6150

Dr. Donald O. McIsaac
Executive Director
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 200
Portland, OR 97220
Telephone: (503) 820-2280

Abstract: The 1996 Sustainable Fisheries Act requires that every federal fishery management plan (FMP) must be consistent with National Standard 9 of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). National Standard 9 requires that "Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch." Section 303(a)(11) of the Magnuson-Stevens Act requires each FMP "establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery."

The Pacific Fishery Management Council (Council) is responsible for developing fishery management plans (FMPs) that are consistent with the Magnuson-Stevens Act and other applicable law. The Council's Pacific Coast Groundfish FMP includes goals, objectives and management measures addressing bycatch. This Environmental Impact Statement analyzes the Council's objectives for its bycatch mitigation program and evaluates alternative programs to achieve those objectives. Various bycatch mitigation tools are evaluated for effectiveness in reducing unwanted catches of marine species, potential for mitigating other effects on the marine environment, social and economic effects, administrative costs, and other potential impacts. Some alternatives would require more comprehensive scientific observations of catch and bycatch.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
PROGRAM PLANNING AND INTEGRATION
Silver Spring, Maryland 20910

FEB 20 2004

Dear Reviewer:

In accordance with provisions of the National Environmental Policy Act of 1969 (NEPA), we enclose for your review the Pacific Coast Groundfish Draft Programmatic Environmental Impact Statement (DPEIS).

The Pacific Fishery Management Council (Council) and the National Marine Fisheries Service propose to evaluate, at a broad scale, how to minimize bycatch in the West Coast groundfish fisheries to the extent practicable, minimize the mortality of unavoidable bycatch, and ensure that bycatch is reported and monitored as required by law. The proposed action would establish the policies and program direction to achieve this purpose. When this Programmatic Environmental Impact Statement (PEIS) is final, the Council is expected to immediately undertake preparation of a new groundfish fishery management plan amendment that will include the conservation and management measures necessary to minimize bycatch and to minimize the mortality of bycatch that cannot be avoided, to the extent practicable. This DPEIS is intended to provide the analytical underpinnings for that effort.

The purpose of the proposed action is to (1) account for total fishing mortality by species, (2) establish monitoring and accounting mechanisms to keep total catch of each groundfish stock from exceeding the specified limits, (3) reduce unwanted incidental catch and bycatch of groundfish and other species, (4) reduce the mortality of animals taken as bycatch, (5) provide incentives for fishers to reduce bycatch and flexibility/opportunity to develop bycatch reduction methods, (6) monitor incidental catch and bycatch in a manner that is accurate, timely, and not excessively costly, (7) reduce unobserved fishing-caused mortalities of all fish, and (8) gather information on unassessed and/or non-commercial species to aid in development of ecosystem management approaches.

Additional copies of the DPEIS may be obtained from the Pacific Fishery Management Council 7700 NE Ambassador Place, Suite 200, Portland, Oregon 97220-1384. The document is also accessible through the Pacific Fishery Management Council's website at http://www.Pcouncil.org. The document is also accessible through the NMFS Northwest Region website at http://www.nwr.noaa.gov/1sustfsh/groundfish/eis_efh/pseis/.

Comments or questions on the DPEIS submitted during the 60-day public comment period must be received by April 27, 2004. Written comments should be submitted by mail to D. Robert Lohn, Regional Administrator, Northwest Region, NMFS, NOAA, 7600 Sand Point Way N.E., Bldg. 1, Seattle, WA 98115-0070. Comments may be submitted by facsimile (fax) to 206-526-6736. Electronic comments may be submitted by e-mail to Bycatch.nwr@noaa.gov; include in the comment subject line "Comments on the Pacific Coast Groundfish Bycatch Draft Programmatic EIS". A copy of your comments should be submitted to me by mail at the NOAA

Strategic Planning Office (PPI/SP), SSMC3, Room 15603, 1315 East-West Highway, Silver Spring, Maryland 20910; or by fax to 301-713-0585; or by e-mail to nepa.comments@noaa.gov.

Sincerely,

Susan A. Kennedy
Acting NEPA Coordinator

Enclosure

The Pacific Coast Groundfish Fishery Management Plan

Bycatch Mitigation Program

Draft Programmatic Environmental Impact Statement

February 2004

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Executive Summary

The Proposed Action is to establish policies and program direction that minimize bycatch to the extent practicable, minimize the mortality of unavoidable bycatch, and ensure that bycatch is reported and monitored as required by law.

ES.1 The Proposed Action

The Pacific Fishery Management Council (Council) and National Marine Fisheries Service (NMFS, also called NOAA Fisheries - National Oceanic and Atmospheric Administration, U.S. Department of Commerce) propose to evaluate, at a broad scale, how to minimize bycatch in the West Coast groundfish fisheries to the extent practicable, minimize the mortality of unavoidable bycatch, and ensure that bycatch is reported and monitored as required by law. The proposed action would establish the policies and program direction to achieve this purpose. When this Programmatic Environmental Impact Statement (PEIS) is final, the Council is expected to immediately undertake preparation of a new groundfish fishery management plan amendment that will include the conservation and management measures necessary to minimize bycatch and to minimize the mortality of bycatch that cannot be avoided, to the extent practicable. This PEIS is intended to provide the analytical underpinnings for that effort.

ES.1.1 Why is Action Needed?

The 1996 Sustainable Fisheries Act requires that every federal fishery management plan (FMP) must be consistent with National Standard 9 of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). National Standard 9 requires that "Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch." Section 303(a)(11) of the Magnuson-Stevens Act requires each FMP "establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery, and include conservation and management measures that, to the extent practicable and in the following priority –

(A) minimize bycatch; and
(B) minimize the mortality of bycatch which cannot be avoided."

The Council's Groundfish FMP includes provisions relating to bycatch mitigation. Some measures, such as gear definitions and restrictions, have been established as long-term regulations that remain in effect for until the Council and NMFS amend them. Other measures are established through the annual management process and expire at the end of each year (or every two years, under the Council's new two-year management process). The current bycatch mitigation program is not clearly spelled out in a single place. Rather, elements are spread throughout the FMP, the regulations as recorded in the *Code of Federal Regulations*, various FMP amendments, and numerous *Federal Register* notices. The proposed action is needed to describe the elements of the groundfish bycatch program, to identify the various bycatch mitigation tools available to the Council, to evaluate the effects and effectiveness of those tools, and to evaluate potential improvements that might result from other combinations and applications of bycatch mitigation tools. A comprehensive program to minimize bycatch and bycatch mortality to the extent practicable in the groundfish fishery would (1) reduce waste, discard, and collateral damage to marine plants and animals by groundfish fishing activities on the Pacific coast, (2) collect and report appropriate and adequate information to support the groundfish fishery management program, and (3) balance these needs with environmental and social values (i.e., need to allow for fishing).

ES.1.2 What is the Purpose of the Proposed Action?

The Council appointed an ad hoc Environmental Impact Statement Oversight Committee (Committee) to provide direction to drafters of this EIS. The committee identified the following objectives for the groundfish bycatch mitigation program. These objectives define the purpose of the proposed action:

- account for total fishing mortality by species
- establish monitoring and accounting mechanisms to keep total catch of each groundfish stock from exceeding the specified limits
- reduce unwanted incidental catch and bycatch of groundfish and other species
- reduce the mortality of animals taken as bycatch
- provide incentives for fishers to reduce bycatch and flexibility/opportunity to develop bycatch reduction methods
- monitor incidental catch and bycatch in a manner that is accurate, timely, and not excessively costly
- reduce unobserved fishing-caused mortalities of all fish
- gather information on unassessed and/or non-commercial species to aid in development of ecosystem management approaches.

This draft EIS has been prepared as a programmatic document to assist the Council and NOAA Fisheries in taking the next steps necessary to meet the bycatch requirements of the Magnuson-Stevens Act.

ES.1.3 Background

Since 1996, the Council prepared two FMP amendments to bring the FMP into compliance with the Magnuson-Stevens Act requirements. The first attempt was Amendment 11. NMFS disapproved the bycatch provisions of that amendment as inadequate and returned it to the Council for further consideration. The Council and NMFS worked together to prepare Amendment 13, which NMFS subsequently approved. However, the amendment was challenged in federal district court. The court disapproved Amendment 13 and its accompanying Environmental Assessment (EA) as inadequate in Pacific Marine Conservation Council v. Evans, 200 F.Supp.2d 1194 (N.D. Calif. 2002). This court ruling is referred to as PMCC in this EIS. In PMCC, the court made several rulings with respect to the adequacy of the Amendment 13 bycatch revisions and the EA. The court held that Amendment 13 failed to establish a standardized reporting methodology because it established neither a mandatory nor an adequate observer program. Further, the amendment did not minimize bycatch and bycatch mortality because it failed to include all practicable management measures in the FMP itself. The court also found a lack of reasoned decisionmaking, as the amendment rejected four specific bycatch reduction measures (fleet size reduction, marine reserves, vessel incentives, and discard caps) without consideration on their merits. With respect to NEPA, the EA prepared for Amendment 13 failed to address adequately the ten criteria for an action's significance set forth in the CEQ regulations at 40 CFR 1508.27(b), and also failed to analyze reasonable alternatives, particularly the immediate implementation of an adequate at-sea observer program and bycatch reduction measures.

This draft EIS addresses the specific legal deficiencies identified by the court in the PMCC decision. When the EIS is final, the Council is expected to immediately undertake preparation of a new FMP amendment that will include the conservation and management measures necessary to minimize bycatch and to minimize the mortality of bycatch that cannot be avoided, to the extent practicable. This EIS is intended to provide the analytical underpinnings for that effort. In addition to other bycatch mitigation tools, it includes consideration of fleet size reduction, marine reserves, vessel incentives, and discard caps, as required by the PMCC decision.

Since the early 1990s the FMP required fishing vessels to carry observers at the request of NMFS. In August 2001, a mandatory observer program was begun under these regulations. This program is conducted by the Fishery Resource Analysis and Monitoring Division of the NMFS Northwest Fisheries Science Center. Later, the Council and NMFS adopted a mandatory observer program in FMP Amendment 16-1. NMFS approved this amendment on November 14, 2003.

The Groundfish FMP covers more than 80 species of groundfish, many of which are caught together with a variety of fishing gears that are used to target groundfish. Groundfish are also caught incidentally in fisheries for non-groundfish species such as pink shrimp and California halibut. As of January, 2004, nine groundfish species have been declared overfished. These are darkblotched rockfish, canary rockfish, lingcod, yelloweye rockfish, bocaccio rockfish, cowcod (also a rockfish species), widow rockfish, Pacific ocean perch (another rockfish), and Pacific whiting. The Council has prepared (or is in the process of preparing) a plan to rebuild each of these species.

The groundfish fishery off the West Coast of the United States is executed from the Canadian to Mexican borders. Multiple vessel types participate in this fishery. They range in size from 8 foot long kayaks to 120 foot trawlers, and vessels fish in nearshore to offshore waters. The vessels use various types of gear including bottom trawls, midwater trawls, pots, longlines and other hook and line gear. Trawlers take the majority of groundfish. The catch can be incredibly diverse in species and fish size and overall catch size can vary widely as well. In many cases, a portion of the catch is retained and another portion of the catch, that may be of the wrong size, species, or is over management retention limits, is discarded at sea. Discarded fish are called "bycatch."

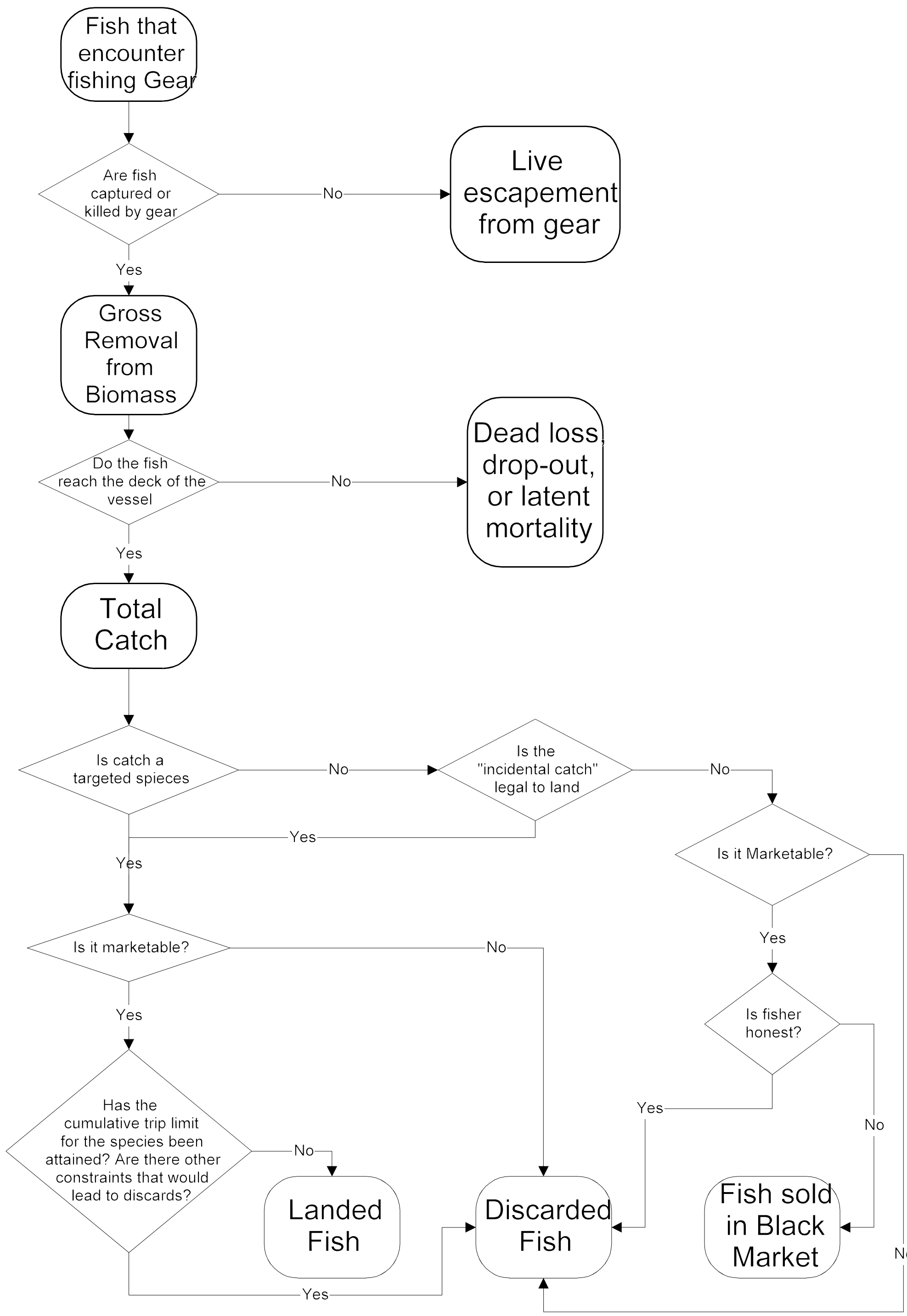
Figure ES.1 illustrates the meaning of bycatch and other catch-related terms as they are defined and used in the Magnuson-Stevens Act and Groundfish FMP. Some fish encounter fishing gear but escape alive. However, there will almost always be some unobserved mortality resulting from injury when fish encounter fishing gear, especially mass-contact types of gear, such as trawl gear. The latent or "pass-through" mortality of fish escaping from a trawl net may be quite high, depending on the design and manner in which the gear is fished as well as its mesh size. Additional delayed mortality may occur after fish escape gear. This type of morality may be related to the stress of capture and physiological injuries which subsequently turn out to be fatal. There may also be mortality associated with gear that is lost or abandoned — the bycatch resulting from this "ghost fishing." NMFS considers this unobserved fishing-related mortality included in the definition of bycatch because it constitutes a harvest of fish that are not sold or kept for personal use (63 FR 24235 May 1, 1998).

ES.2 Measuring Environmental Consequences

Short-term effects are mortalities resulting from fisheries, including harvest and incidental mortality that occurs when fishers capture and then release groundfish and other species. Long-term effects are changes in the abundance of successive generations of the affected stock that may occur as a result of reductions in short-term impacts and the consequent increase in the species' populations. These effects are qualitatively described.

Cumulative effects are changes to groundfish stocks and other marine animal populations that may result from a combination of short- and long-term effects of the actions in the groundfish fisheries, along with the effects of other past, present, or foreseeable future actions. Changes to the human environment stem from modifying management measures and the conduct of fisheries. These are described in terms of bycatch mitigation tools: changes in harvest specifications, season duration and structure, harvest, fishing effort, commercial fisheries, and angler benefits. Social and cultural effects are qualitatively described for the communities of commercial and recreational fishers and for coastal communities and Tribes.

Figure ES.1. Diagrammatic representation of bycatch and other catch-related terms.



ES.3 The Alternatives

The Council's ad hoc EIS Committee developed five alternatives to the current bycatch management program. Each of these alternatives would use many of the current mitigation tools, but may use different combinations or may apply some differently. Alternative 1 is the no action/status quo. It describes the current bycatch program. Alternative 2 would emphasize capacity reduction, which means reducing the size of the commercial groundfish fleet. Specifically, it would reduce the trawl fleet by half (50%) from the number permitted to fish in 2002-2003. Since this alternative was proposed, a federal buyback program was approved, resulting in 91 trawl vessels being permanently eliminated. That buyback program "watered down" the effects of Alternative 2. Alternative 3 would reduce fishing effort by reducing the amount of groundfish fishing time for every commercial vessel. This might be through shorter seasons, establishing fishing "platoons," or other methods to limit fishing. Alternative 4 would revise the definition of the term "trip limit" to include a requirement that vessel stop fishing when the limit is reached. Specifically, it would use a combination of catch limits and trip limits, and each fishing sector would be held to a specified limit or cap of overfished species. If vessels in a sector reached the limit, all vessels in the sector would be closed. Alternative 5 would replace trip limits with individual fishing quotas, which would be defined as catch or mortality limits. Quota holders would be allowed to buy and sell shares. Discard caps for overfished species would be established also. Alternative 6 would focus on reducing bycatch to near zero by establishing no-take marine reserves, individual vessel catch quotas, and prohibiting discard of most groundfish. The details of these alternatives are spelled out in Chapter 2 and further described in Chapter 4.

Table ES.1. Bycatch reduction methods (bycatch mitigation tools) included in the alternatives.

Goals and Objectives	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
	No action: Control bycatch by trip (retention) limits that vary by gear, depth, area; long season. Use marine protected areas (RCAs)	Same as Alt. 1 but reduce trawl fleet and increase trip limits to match smaller fleet.	Same as Alt 1 but reduce commercial fishing time by seasons or other method, and increase trip limits.	Similar to Alt 1, but establish vessel and sector catch limits for overfished groundfish. Trip limits for other groundfish.	Establish individual catch limits (individual quotas) for groundfish species. Set discard caps for overfished species.	Establish no-take reserves, individual vessel catch limits (individual quotas). Prohibit all groundfish discards.
FISHERY MANAGEMENT TOOLS						
Harvest Levels						
ABC/OY	Y	Y	Y	Y	Y	Y
Set **overfished groundfish catch caps**	N	N	N	Y	N	Y
Use **trip limits**	Y	Y	Y	Y	N	N
Use **catch limits**	N	N	N	Y	Y	Y
Set individual vessel/permit catch	N	N	N	Y	Y	Y
Set groundfish **discard caps**	N	N	N	N	Y	Y
Establish **IQs**	N	N	N	N	Y	Y
Establish bycatch **performance standards**	N	N	N	N	Y	Y
Establish a reserve	N	N	N	Y	N/Y	Y
Gear Restrictions						
Rely on **gear restrictions**	Y	Y	Y	Y	N	Y
Time/Area Restrictions	Y	Y	Y	Y	Y	Y
Establish **long term closures for all groundfish fishing**	N	N	N	N	N/Y	Y
Establish **long term closures for on-bottom fishing**	N	N	N	N	N/Y	Y
Capacity reduction (mandatory)	Y	Y(50%)	Y	Y	Y	Y
Monitoring/Reporting						
Trawl logbooks	Y	Y	100%	Y		
Fixed-gear logbooks	N	N	100%	Y		
CPFV logbooks	N	N	N	Y		
Commercial **port sampling**	Y	Y	Y	>Y	N/Y	Y
Recreational	Y	Y	Y	>Y	Y	>>x
Observer coverage (commercial)	10%	10%	10%+logbook verification	increased, by sector	100%	100%
CPFV observers	N	N	N	Y	Y	100%
VMS	Y	Y	Y	Y	Y	Y
Post-season observer data OK	Y	Y	Y	N	N	N
Inseason observer data required	N	N	N	Y	Y	Y
Rely on fish tickets as the primary monitoring device for groundfish landings	Y	Y	Y	N	N	N

ES.4 Environmental Impacts of the Alternatives

Chapter 4 describes numerous environmental impacts that may occur if no action is taken or if any of the alternatives is adopted. No regulations would be imposed by any of the alternatives. However, if the Council adopts one of the alternative bycatch mitigation programs, an amendment to the FMP and implementing regulations would be prepared. Further, more detailed environmental analysis might be required at that time. The results of the analyses of impacts are summarized in Tables ES.2 through ES.6 at the end of this section.

Each alternative substantially reduces bycatch compared to an unregulated groundfish fishery. The status quo minimizes bycatch by establishing large marine protected areas that greatly reduce the likelihood that fishers will catch any overfished species within the boundaries. Thus, these MPAs nearly eliminate encounter/bycatch of overfished species within the boundaries, and also bycatch of other fish. The use of trip (retention) limits outside the MPAs will continue to result in regulatory discard/bycatch of groundfish, both overfished and non-overfished species. Economic discard/bycatch of small or otherwise low-value groundfish will continue. The groundfish observer program will monitor a fraction of active commercial fishing vessels.

Alternative 2 would be expected to reduce regulatory bycatch of groundfish. The degree of reduction depends on how constraining current trip limits are; bycatch of species that are typically discarded for economic (non-regulatory) reasons would not be reduced significantly. Bycatch of non-groundfish would not be directly affected. However, reduced commercial trawl fishing effort would be expected to reduce fishing impacts. Because the groundfish trawl fleet has recently been reduced by 91 vessels, the amount of change from Alternative 2 would be substantially less than originally expected. The level of observer coverage would be increased, resulting in a larger fraction of active commercial fishing vessels being observed. This would improve bycatch information.

Alternative 3 would be expected to reduce regulatory bycatch of groundfish to a similar degree as Alternative 2. Groundfish regulatory bycatch would be reduced as a result of larger trip limits. However, shorter fishing periods could result in different bycatch patterns, and could also increase a “race for fish” as fishers would fish harder at the beginning of the season in case of premature season closure. Predicting fishing effort, which is required for developing trip limits, would be severely compromised. While it may be possible to maintain some groundfish product flow to markets over much of the year, no vessels would be permitted to operate for more than a few months.

Alternative 4 would substantially reduce groundfish regulatory discard/bycatch (compared to the status quo) by assigning every commercial limited entry vessel to one or more sectors. Annual catch limits for each overfished species would be established for each sector. All vessels in a sector would be required to stop fishing for the remainder of the year if any of its caps was reached. In addition, individual vessel fishing mortality caps would be established to prevent premature closure due to a few “dirty” vessels with high bycatch rates. These catch limits would be similar to trip limits, except that a vessel reaching any cap must stop fishing for the remainder of the cumulative period. The observer program would be restructured to monitor bycatch in each sector, with data available inseason. Vessels carrying observers would have larger trip limits for non-overfished groundfish; vessels could provide an observer at their expense to gain access to the larger limits. Non-regulatory bycatch of groundfish and other species would not be significantly affected by this alternative unless all trip limits were defined as catch limits. In that case, vessels would retain a larger proportion of groundfish because all catch would apply towards the vessel limits.

Alternative 5 would establish a "rights-based" program of individual fishing quotas. These would be annual catch limit shares that could be traded or sold. Reaching any quota would require the vessel to stop fishing until it obtained additional quota. The observer program would be expanded to cover all commercial vessels participating in the quota program. The value of restricted species quota (RSQ) shares (for overfished species) would increase; initial shares for some severely depleted species (such as canary and yelloweye rockfish) would be less than 100 pounds. All catch of overfished species must be retained. This alternative would substantially reduce groundfish both regulatory and economic bycatch; encounter/bycatch and discard/bycatch would be reduced. The pace of fishing would likely slow substantially, providing greater opportunity to avoid bycatch of other species also. Catch and bycatch data on all species would be improved substantially. Gear regulations would be relaxed to allow and encourage experimentation and development of gear and techniques that would eventually reduce bycatch as much as technically feasible. Administration costs related to the observer and quota monitoring programs would increase substantially. This would be partially offset by a reduced pre-season process for developing trip limits and other management measures; the process of inseason trip limit adjustments would no longer be needed. Adverse impacts to the marine biological environment would be significantly reduced compared to Alternatives 1, 2, 3 and 4. Social and economic conditions would be significantly affected; some changes would be beneficial, some would be adverse, depending on the individual and the quota program design.

Alternative 6 would establish large no-take marine reserves that would eliminate encounter/bycatch of all species (both groundfish and non-groundfish) within the boundaries. Individual catch quotas, similar to those of Alternative 5, would be established. Groundfish discard caps would nearly eliminate groundfish discard/bycatch. However, unless exceptions were established, these discard caps would increase the mortality of bycatch that could not be avoided. In addition, disposal of unusable fish on land would increase. Observers would monitor catch and bycatch of all commercial vessels (except those without adequate space or facilities). Monitoring of recreational fisheries would also be increased. Commercial vessels would be required to use only gears that had been certified as "low bycatch." This would substantially reduce bycatch in the short term compared to all other alternatives. However, Alternative 5 would be expected to develop more effective bycatch avoidance gears and methods over time because innovation would be allowed. Adverse impacts to the marine biological environment would be significantly reduced compared to Alternatives 1, 2, 3 and 4. Adverse impacts may or may not be reduced compared to Alternative 5. Social and economic conditions would be significantly affected, especially short-term adverse impacts resulting from no-take reserves, gear restrictions and discard prohibitions. Long-term beneficial effects would be faster rebuilding of overfished gr stocks, fish habitat renewal and growth, larger and more numerous fish near reserve boundaries, and areas where relatively un-fished ecosystems can develop.

ES.5 Practicability of Bycatch Minimization Methods

The Council must determine which bycatch mitigation program is environmentally preferred. That alternative may or may not be the one the Council chooses as its preferred (adopted) alternative. Part of the decision will be based on a determination of what management tools are "practicable." The information and analysis provided in Chapters 3 and 4 of this draft EIS will help the Council make that determination.

Table ES.2. Summary of how well alternatives achieve the stated purposes for the proposed action.

Purpose of Proposed Action	**Alt 1 (no action)**	**Alt 2**	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6**
Account for total fishing mortality by species	The current observer program provides statistically reliable estimations of groundfish mortalities.	I+	I+	S+	S+	S+
Establish monitoring and accounting mechanisms to keep total catch of each groundfish stock from exceeding the specified limits	Trip and bag limits, application of the "bycatch model" and inseason tracking of landings are moderately effective but less than 100% successful.	I+	I+	S+	S+	S+
Reduce unwanted incidental catch and bycatch of groundfish and other species	Area closures (Rockfish Conservation Areas), seasons and gear restrictions reduce unwanted catch. Trip limits create regulatory bycatch (discard).	I	I	S+	S+	S+
Reduce the mortality of animals taken as bycatch	Prohibited species must be returned to the sea as quickly as possible with minimum of injury.	U	U	U	U	S-
Provide incentives for fishers to reduce bycatch and flexibility/opportunity to develop bycatch reduction methods	Trip limits reduce the "race for fish" and provide some minimal opportunity and incentives to avoid bycatch.	I+	I-	CS+	S+	CS+
Monitor incidental catch and bycatch in a manner that is accurate, timely, and not excessively costly	The current program minimizes user and agency costs of monitoring catch and bycatch at the expense of precision and timeliness.	I	I	S+/S-	S+/S-	S+/S-
Reduce unobserved fishing-caused mortalities of all fish	Area closures (RCAs), gear definitions and seasons mitigate potential mortalities.	I	I	CS+	S+	S+
Gather information on unassessed and/or non-commercial species to aid in development of ecosystem management approaches.	Over a period of years, information on non-commercial and unassessed stocks will improve.	I	I	CS+	S+	S+

Performance Ratings, compared to status quo/no action alternative:

Substantial Beneficial (S+): Substantial improvement from status quo expected.

Substantially Adverse (S-): Substantially increased costs or reduced effectiveness expected.

Conditionally Substantial Beneficial (CS+): Substantial improvement expected if certain conditions are met or events occur, or the probability of improvement is unknown.

Conditionally Substantial Adverse (CS-): Substantially increased costs expected if certain conditions met, or the probability of occurrence is unknown.

Insubstantial Beneficial (I+)/Insubstantial Adverse (I-): Changes are anticipated but not expected to be major.

Unknown (U): This determination is characterized by the absence of information sufficient to adequately assess the direction or magnitude of the impacts.

Table ES.3. Significance of effects on the biological environment.

Resource	Alt 1 (no action)	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
Groundfish	The current bycatch program provides statistically reliable estimations of groundfish bycatch and bycatch mortalities and mitigates many potential impacts. Trip and bag limits, application of the "bycatch model" and inseason tracking of landings are moderately effective but less than 100% successful in preventing overfishing. Trip limits create regulatory bycatch of groundfish.	I+	I+	S+	S+	S+
Other Relevant Fish, Shellfish and Squid	Impacts on species such as Pacific halibut are reduced from recent years due to large area closures to protect overfished groundfish (primarily rockfish).	U	U	S+	S+	S+
Protected Species	Area closures (Rockfish Conservation Areas), seasons and gear restrictions reduce potential catches. Protected species must be returned to the sea as quickly as possible with minimum of injury.	I+	I-	CS+	CS+	CS+
Salmon	Salmon bycatch in the Pacific whiting fisheries is closely monitored. Voluntary bycatch avoidance methods have proven effective, especially in the at-sea sectors	U	U	I+	I+	CS+
Seabirds	Few seabird interactions have been documented; seasons and area closures could increase or decrease interactions.	I+	I-	CS+	CS+	CS+
Marine Mammals	Few marine mammal takings have been documented, and all are within current standards.	I+	I-	S+/ S-	CS+	CS+
Sea Turtles	No sea turtle interactions have been observed in the groundfish fisheries.					
Miscellaneous Species	Area closures (RCAs), gear definitions and seasons mitigate potential mortalities. Little information is available.	U	U	CS+	CS+	S+
Biological Associations	Over a period of years, information on non-commercial and unassessed stocks will improve. Little information is available at this time.	U	U	CS+	S+	S+

Significance Ratings, compared to status quo/no action alternative:

Significant Beneficial (S+): Significant improvement from status quo expected.
Significant Adverse (S-): Significantly increased adverse impacts or reduced effectiveness expected.
Conditionally Significant Beneficial (CS+): Significant beneficial impacts expected if certain conditions are met or events occur (such as full observer coverage), or the probability of impacts is unknown.
Conditionally Significant Adverse (CS-): Significantly increased adverse impacts expected if certain conditions met, or the probability of occurrence is unknown.
Insignificant Beneficial (I+)/Insignificant Adverse (I-): Minor impacts, if any, are anticipated.
Unknown (U): This determination is characterized by the absence of information sufficient to adequately assess the significance of the impacts.

Table ES.4(a). Summary of effects of Alternatives 1, 2 and 3 on the social and economic environment. (Alternatives 4, 5 and 6 are addressed in the following table.)

	Alternative 1	Alternative 2	Alternative 3
Incentives to Reduce Bycatch	Quota-induced discards can occur when fishers continue to harvest other species when the harvest guideline of a single species is reached and further landings of that species are prohibited. As trip limits become more restrictive and as more species come under trip-limit management, discards are expected to increase. In addition, discretionary discards of unmarketable species or sizes are thought to occur widely. However, in comparison to a "race for fish" allocation system, the current management regime provides harvesters a considerable amount of flexibility to reduce unwanted catch and discards.	Reducing the level of effort in the groundfish fisheries and increasing trip limits would likely reduce the level of groundfish bycatch (discard).	If trip limits increase, the level of groundfish bycatch (discard) would be expected to decline.
Commercial Harvesters	By spreading out fishing more evenly over the year, the current management regime helps maintain traditional fishing patterns. However, landings of major target species (other than Pacific whiting) are expected to continue to decline as OYs are reduced to protect overfished species. Declining harvests lead to significant decreases in total groundfish ex-vessel value.	Further fleet reduction would be expected to reduce (but not eliminate) extra capacity in the fishery and to restore the fleet to some minimum level of profitability.	A combination of higher trip limits and a reduction in the length of the fishing season would be expected to lead to an overall reduction in variable fishing costs. With larger trip limits, revenues per trip are expected to increase. However, the overall impact of this alternative on costs and revenues would depend on when individual participants were allowed to fish. For example, fishers may be unable to fish for certain species at optimal times.
Recreational Fishery	Landings of major target species are not expected to increase and may decline further if OYs are reduced to protect overfished species. Decreased harvests lead to significant decreases in recreational value.	Changes in landings of major species targeted in the recreational fishery would be expected to be insignificant.	Effects as described in Alternative 2
Tribal Fishery	Changes in landings of major species targeted in tribal fisheries are expected to be insignificant.	Effects as described in Alternative 1	Effects as described in Alternative 1
Buyers and Processors	The current management regime reduces the likelihood that processing lines will be idle by fostering a regular flow of product to buyers and processors. However, decreased deliveries of groundfish to processors and buyers will result in significant decrease in groundfish product value.	No significant changes in the total amount of fish delivered to processors would be expected. Processors in ports that experience a reduction in fleet size may be negatively affected if they are unable to obtain supplies of fish from alternative sources	Larger trip limits would not be expected to affect the total amount of fish that harvesters deliver to processors. However, with vessels taking longer and potentially fewer trips, processors would have fewer boats to schedule for landings and unloading, reducing their average costs. On the other hand, costs could increase if processors were unable to control the flow of product throughout the year and capital is idle during closed periods.

Table ES.4(a). Summary of effects of Alternatives 1, 2 and 3 on the social and economic environment. (Alternatives 4, 5 and 6 are addressed in the following table.)

	Alternative 1	Alternative 2	Alternative 3
Communities	By maintaining year-round fishing and processing opportunities, the current management regime promotes year-round employment in communities. However, groundfish employment and labor income are expected to continue to decline, resulting in economic hardship for businesses involved in the groundfish fisheries. These businesses are expected continue to diversify to reduce dependence on groundfish fisheries.	The direction and magnitude of many of the economic effects on particular coastal communities are uncertain, as the distribution of the post-buyback fleet is uncertain. If further reduction in fleet capacity with higher trip limits were successful in increasing net revenues or profits to remaining commercial fishers, positive economic impacts on the communities where those fishers land their fish, home port and reside would be expected. On the other hand, some communities may experience a significant loss of vessels and a consequent decrease in income, jobs and taxes.	The impacts are uncertain, as community patterns of fishery participation vary seasonally based on species availability as well as the regulatory environment and oceanographic and weather conditions. If higher trip limits were successful in increasing net revenues or profits to fishers, positive economic impacts on the communities where those fishers land their fish, home port, and reside would be expected. On the other hand, seasonal closures could leave crew members at least temporarily unemployed.
Consumers	The current management regime allows buyers and processors to provide a continuous flow of fish to fresh fish markets, thereby benefitting consumers. Consumers of fresh or live groundfish may be adversely affected by reduced commercial landings. However, changes in benefits to most consumers of groundfish products would be expected to be insignificant due to availability of substitute products.	Effects as described in Alternative 1	Consumers of fresh or live groundfish could be unable to obtain fish from the same sources for half of the year unless the harvest sectors are split into two groups, with one group of vessels active at any given time.
Fishing Vessel Safety	Some gains in fishing vessel safety are at least partially realized under the current management regime, as fishers are able to fish at a more leisurely pace and avoid fishing in dangerous weather or locations. However, safety of human life at sea may decrease if reduced profits induce vessel owners to forgo maintenance, take higher risks or hire inexperienced crews.	Increases in net revenue to harvesters resulting from increases in trip limits may enhance their ability to take fewer risks and use their best judgment in times of uncertainty, thereby increasing vessel safety.	The effects on vessel safety may be mixed. Increases in net revenue to harvesters resulting from increases in trip limits may lead to reductions in injury and loss of life because of harvester's enhanced ability to take fewer risks and use their best judgment in times of uncertainty. However, set seasons make it more difficult for harvesters to make wise decisions as to when and where to fish.
Management and Enforcement Costs	The management regime is expected to continue to be contentious, difficult and expensive. Technological developments such as VMS may mitigate the rate at which management costs escalate.	Costs are expected to decrease, as fewer vessels are generally easier and less expensive to monitor.	Effects will vary depending on the way the seasonal closure is structured. Costs are expected to decline if there is no fishing activity to monitor for 6 months of the year. However, there will be increased costs if permit holders are divided into groups.

Table ES.4(b). Summary of effects of Alternatives 4, 5 and 6 on the social and economic environment. (Alternatives 1, 2 and 3 are addressed in the preceding table.)

	Alternative 4	Alternative 5	Alternative 6
Incentives to Reduce Bycatch	While it would be in the best interest of all vessels within a sector to reduce the catch of overfished species, a "race for fish" could develop in which individual vessels eschew fishing practices that reduce bycatch in order to attain their landing limits as quickly as possible. Setting individual catch limits would prevent that. In addition, if cooperative patterns of behavior emerge, decreases in bycatch would be expected.	The amount of fish discarded by each vessel would be counted against the vessel's limit. This measure provides strong economic incentives to reduce the catch of unwanted fish because it "internalizes" the costs of discarding fish.	MPAs would prohibit fishers from fishing in certain areas in order to reduce the probability that fish will be caught and discarded, while the 100% retention requirement would be the primary means of reducing groundfish bycatch (discard) outside of MPAs. Prohibiting discard would produce a strong incentive to avoid unwanted catch because the costs of sorting, storing, transporting and disposing of fish that cannot be sold may be substantial. If vessel groundfish quotas are transferable, Alternative 6 would be similar to Alternative 5; if not transferable, negative effects would be much more significant and more similar to Alternative 4.
Commercial Harvesters	A reduction in harvest and exvessel revenues could result from early attainment of overfished species sector caps. However, the total amount of fish available for retained harvest would be expected to increase, as vessels would increase retention of groundfish, and the level of bycatch would be measured more accurately through expanded observer coverage. The economic benefit of increased landings must be weighed against the additional operating costs that vessel owners would incur from the expanded observer coverage. The allocation of catch limits to individual sectors could lead to economic benefits if private agreements allocating transferable harvesting privileges were negotiated.	Current vessel owners as a group would likely benefit from a system that allocates freely transferable and leaseable quota shares to vessel owners on the basis of catch histories. Moreover, the total amount of fish available for harvest would increase, as bycatch would be measured more accurately through expanded observer coverage. Not all vessel owners would benefit equally, and the relative benefits would depend on the allocation formula. In addition, the economic benefits must be weighed against the additional operating costs that vessel owners would incur from the expanded observer coverage.	Some measures would significantly increase fishing costs, while other would reduce them. For example, 100% groundfish retention, full observer coverage, and establishment of MPAs would increase average costs, whereas the establishment of ITQs for groundfish species would reduce costs.
Recreational Fishery	This alternative may have a negative economic effect on recreational fishers if its sector catch limit were exceeded. The ability to detect excessive catches within the recreational sector would be enhanced by a CPFV observer program and expanded port/field sampling. The ability of the recreational sector to avoid a fishery closure by controlling catch of overfished species through an incentive program is likely to be limited, as there are many and diverse participants. Dividing the recreational sector into geographical (e.g., state-based) subsectors could mitigate some of the negative effects.	The creation of tradable quota shares for the commercial fishing/processing sectors is not expected to apply to the recreational fishery. The possibility of creating ITQs for recreational fishers may exist, but any discussion of how such a allocation would be achieved or its effects on recreational fishers would be speculative.	Rights-based system effects would be as described in Alternative 5. MPAs could benefit recreational fishers over the long term if local catch rates and fish size increased due to spillage of adults out of the MPAs. On the other hand, if MPAs resulted in geographic redistribution of the commercial and recreational fleets, the concentration of fishing effort in the areas that remain open could lead to localized stock depletion, reduced recreational catch per unit effort, and reduction in the quality of the fishing experience.

Table ES.4(b). Summary of effects of Alternatives 4, 5 and 6 on the social and economic environment. (Alternatives 1, 2 and 3 are addressed in the preceding table.)

	Alternative 4	Alternative 5	Alternative 6
Tribal Fishery	Changes in landings of major species targeted in tribal fisheries are expected to be insignificant.	Effects as described in Alternative 1	Effects as described in Alternative 1
Buyers and Processors	The economic effects on buyers and processing companies are uncertain because of the uncertainty as to how well vessel owners within sectors can successfully manage bycatch. To the extent that commercial harvesters adopt bycatch-reducing fishing tactics, processors and buyers would be expected to benefit from higher catches. On the other hand, if an entire fishing sector is shutdown, buyers and processors may experience significant shortages of fish.	Buyers and processors would be expected to benefit from the anticipated increases in fish landings. The overall level of benefits and the distribution of benefits across processors may depend largely on the formula for allocating quota shares. Arguments have been made that harvester-only ITQ programs may result in stranded capital in the processing sector and a shift in the balance of bargaining power toward harvesters. These potential adverse effects could be mitigated if processors were also allocated quota shares.	The net economic effect on buyers and processors is uncertain. In general, buyers and processors would be expected to benefit from the anticipated increases in fish landings that result from the implementation of a rights-based system. The 100% retention requirement could also result in a large increase in landings. However, it is uncertain how much of the additional fish retained would be marketable. Because of their lack of mobility, buyers and processors may be especially negatively affected by MPAs. However, the effects of MPAs on specific buyers and processing companies will depend in part on changes in local supply and how processors have adapted to current supply situations.
Communities	To the extent that harvesting sectors are not shut down, no significant economic impact on communities is likely. However, if sector closures occurred, there would likely be negative impacts in fishing communities, particularly if processing plants were also closed.	Consolidation of fishing and processing activities to fewer vessels and plants would likely result in reductions in the numbers of crew members and processing workers employed. Granting quota shares to community groups could help maintain existing harvesting and processing patterns and serve to meet concerns about employment in communities.	Effects of a right-based management system as described in Alternative 5. MPAs would be expected to help ensure harvests for future generations and the sustained participation of communities in groundfish fisheries. If, however, MPAs resulted in substantial decreases in groundfish catches over the short term, the economic hardships that fishing families and other members of communities are experiencing under Alternative 1 (no action) would be exacerbated.
Consumers	If no early closures of major harvesting sectors occur, the impact on consumers would be expected to be negligible. However, if major fishing sectors were shut down, consumers of fresh or live groundfish could be adversely affected.	Consumers would be expected to benefit from the anticipated increases in fish landings. There is some chance that consumers could be negatively affected, if a rights-based system leads to a decrease in the overall competitiveness of markets for certain groundfish products (e.g., live fish). The likelihood of this occurring would depend both on the level of consolidation that might occur and the elasticity of demand for particular products.	Consumers would benefit from the anticipated increased landings that result from a rights-based system. In addition, over the long term, MPAs that effectively increase the size and variety of seafood species could make consumers better off. On the other hand, large MPAs could substantially decrease seafood supply enough to make consumers worse off, at least in the short term. MPAs could have a positive effect on those consumers who derive non-consumptive benefits from marine ecosystems, including non-market benefits (e.g., existence value).
Fishing Vessel Safety	The effects on vessel safety are uncertain. Possible increases in the profitability of harvesting operations could lead to reductions in injury and loss of life because of harvesters' enhanced ability to maintain equipment, take fewer risks and use their best judgment in times of uncertainty. Without	Possible increases in the profitability of harvesting operations would likely lead to reductions in injury and loss of life because of harvesters' enhanced ability to maintain equipment, take fewer risks and use their best judgment in times of uncertainty.	The net effect of the various measures included in this alternative on fishing vessel safety is uncertain. The establishment of ITQs for groundfish species is expected to promote vessel safety by reducing the pressure to fish under dangerous conditions. On the other hand, the establishment of MPAs may result in a

Table ES.4(b). Summary of effects of Alternatives 4, 5 and 6 on the social and economic environment. (Alternatives 1, 2 and 3 are addressed in the preceding table.)

	Alternative 4	Alternative 5	Alternative 6
	individual vessel catch limits, if an intense "race for fish" could develop. The increased competition among fishers would likely increase the risks they would be willing take to harvest fish.		reduction in fishing vessel safety if the closure of fishing grounds results in vessels fishing farther from port and possibly in more hazardous areas.
Management and Enforcement Costs	Costs would be expected to increase as catch limits were allocated over an increasing number of sectors. It would be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches within each sector. An expanded port/field sampling program to improve estimates of recreational catch would entail a larger budget for the state and federal agencies currently involved in data collection.	The costs of monitoring, enforcement and administration would be expected to increase significantly. Cost recovery measures such as a fee on quota holders would be expected.	Full (100%) observer coverage would be required, which would facilitate enforcement of a full retention regulation. The enforcement costs of establishing MPAs vary with several factors, including the location, number, size, and shape of the MPAs and types of activities restricted and allowed.

Table ES.5. Significance of effects on the social and economic environment.

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Incentives to Reduce Bycatch	CS+/CS-	CS+	CS+	S+	S+	S+
Commercial Harvesters	S+	S+	CS+	CS+/CS-	S+/S-	S+/S-
Recreational Fishery	S-	I	I	CS-	I	S+/S-
Tribal Fishery	I	I	I	CS-	I	CS-
Buyers and Processors	S+/S-	I/CS-	I/CS-	CS+/CS-	CS+	CS+/CS-
Communities	S+/S-	CS+/CS-	CS+/CS-	CS-	CS+	CS+/CS-
Consumers	S+/S-	I	CS-	CS-	CS+	CS+/CS-
Fishing Vessel Safety	S+/S-	S+	S+/S-	CS-	S+	S+/S-
Management and Enforcement Costs	S-	S+	CS+/CS-	S-	S-	S-

Significance Ratings:

Significantly Adverse (S-): Significant adverse impact based on ample information and the professional judgment of the analysts.

Conditionally Significant Beneficial (CS+)/Conditionally Significant Adverse (CS-): Conditionally significant is assigned when there is some information that significant impacts could occur, but the intensity of the impacts and the probability of occurrence are unknown.

Insignificant Impact (I): No significant change based on information and the professional judgment of the analysts..

Unknown (U): This determination is characterized by the absence of information sufficient to adequately assess the significance of the impacts.

Table ES.6(a). Summary of direct, indirect and cumulative effects of Alternatives 1, 2 and 3.

Resource Issue or Category	Alternative 1	Alternative 2	Alternative 3
Habitat: Trawl and other gear contacting the bottom damage benthic organisms and physical structure			
Direct/Indirect	No change from baseline	No change from baseline	No change from baseline
Cumulative	No change from baseline	No change from baseline	No change from baseline
Ecosystem/Biodiversity: Lowered abundance of particular species changes ecosystem structure, stock declines lead to local/regional extinction.			
Direct/Indirect	No change from baseline	No change from baseline	No change from baseline
Cumulative	No change from baseline	No change from baseline	No change from baseline
Groundfish: Bycatch and bycatch mortality of overfished and other groundfish			
Direct/Indirect	Catch rates of overfished species such as canary and bocaccio rockfish may delay or prevent rebuilding. Discard/bycatch of other groundfish could remain high due to constraints for overfished species.	Reduced fishing effort expected to reduce bycatch and bycatch mortality of overfished and other groundfish. Latent capacity remains and could negate any savings.	Effects may be similar to Alternative 1 if shortened season does not result in larger trip limits.
Cumulative	Canary and bocaccio rockfish may not be sustainable.	Higher probability of rebuilding overfished species. Reduced bycatch and bycatch mortality of other groundfish may allow fuller resource utilization but not necessarily increased abundance.	Effects may be similar to Alternative 1 if shortened season does not result in larger trip limits.
Protected species: Bycatch and bycatch mortality of Pacific halibut, Pacific salmon, marine birds and mammals.			
Direct/Indirect	No change from baseline	No change from baseline	Interactions are thought to be low, but may be completely absent during seasonal closures. Halibut bycatch depends on timing of seasonal closures.
Cumulative	No change from baseline	No change from baseline	Interactions with birds depend on timing of seasonal closures.
Accountability: Increased monitoring bycatch and bycatch mortality improves accountability.			
Direct/Indirect	Provides for statistically reliable measures of bycatch on an annual basis, but not inseason.	Marginal improvement in monitoring coverage of trips.	Marginal improvement in monitoring coverage of trips
Cumulative	Lack of timely inseason data may lead to unsustainable fisheries for some overfished species.	Similar to Alternative 1 - data cannot be used in-season.	Similar to Alternative 1 - data cannot be used in-season

Table ES.6(b). Summary of direct, indirect and cumulative effects of Alternatives 4, 5, and 6 for West Coast groundfish fisheries.

Resource Issue or Category	Alternative 4	Alternative 5	Alternative 6
Habitat: Trawl and other gear contacting the bottom damage benthic organisms and physical structure			
Direct/Indirect	No change from baseline	Reduction in closed areas	Reduction in closed areas
Cumulative	No change from baseline	Increased growth of living benthic habitat (sponges and corals) in closed areas.	Increased growth of living benthic habitat (sponges and corals) in closed areas.
Ecosystem/Biodiversity: Lowered abundance of particular species changes ecosystem structure, stock declines lead to local/regional extinction.			
Direct/Indirect	No change from baseline	Increased growth and abundance of some species in closed areas	Increased growth and abundance of some species in closed areas
Cumulative	No change from baseline	Increased biodiversity in closed areas	Increased biodiversity in closed areas
Groundfish: Bycatch and bycatch mortality of overfished and other groundfish			
Direct/Indirect	Reduces bycatch and bycatch mortality of overfished species in particular - due to RSQ caps for overfished species.	Reduces bycatch and bycatch mortality of overfished and other groundfish through use of MPAs, RSQs and IFQs for overfished and other groundfish.	Reduces bycatch and bycatch mortality of all groundfish through use of no-take reserves, RSQs, IFQs, and 100% groundfish retention requirement.
Cumulative	Higher likelihood and rate of rebuilding, with possible exception of bocaccio rockfish.	Higher likelihood and rate of rebuilding of overfished groundfish, possible increases in other groundfish populations.	Highest likelihood and rate of rebuilding of overfished groundfish. Increased size and diversity of groundfish within closed areas.
Protected species: Bycatch and bycatch mortality of Pacific halibut, Pacific salmon, marine birds and mammals.			
Direct/Indirect	No change from baseline.	Small reductions in bycatch and bycatch morality within protected areas.	Small reductions in bycatch and bycatch morality within protected areas.
Cumulative	No change from baseline.	No change from baseline.	No change from baseline.
Accountability: Increased monitoring bycatch and bycatch mortality improves accountability.			
Direct/Indirect	Significantly improved monitoring coverage. In-season data can be used to make in-season adjustments. Accurate in-season accounting of overfished stocks of groundfish.	Significantly improved monitoring coverage with 100% observer coverage of commercial fleet. Real-time accounting of groundfish. Discard/ bycatch of overfished groundfish nearly eliminated.	Significantly improved monitoring coverage with 100% observer coverage of commercial fleet. Real-time accounting of all groundfish catch. No groundfish discard/bycatch.
Cumulative	Reduced risk and higher likelihood of rebuilding overfished stocks of groundfish.	Reduced risk and higher likelihood of rebuilding overfished groundfish stocks.	Reduced risk and higher likelihood of rebuilding overfished groundfish stocks.

1.0 Purpose of and Need for Action

1.1 The Proposed Action

The *PACIFIC FISHERY MANAGEMENT COUNCIL* (*COUNCIL*) and *NATIONAL MARINE FISHERIES SERVICE* (*NMFS*, also called *NOAA FISHERIES* - National Oceanic and Atmospheric Administration, U.S. Department of Commerce) propose to evaluate, at a broad scale, how to minimize *BYCATCH* in the West Coast groundfish fisheries to the extent practicable, minimize the mortality of unavoidable bycatch, and ensure that bycatch is reported and monitored as required by law. The proposed action would establish the policies and program direction to achieve this purpose. When this *PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT (PEIS)* is final, the Council is expected to immediately undertake preparation of a new groundfish fishery management plan amendment that will include the conservation and management measures necessary to minimize bycatch and to minimize the mortality of bycatch that cannot be avoided, to the extent practicable. This PEIS is intended to provide the analytical underpinnings for that effort.

1.2 Need for the Proposed Action

The Proposed Action is to establish policies and program direction that minimize bycatch to the extent practicable, minimize the mortality of unavoidable bycatch, and ensure that bycatch is reported and monitored as required by law.

The 1996 *SUSTAINABLE FISHERIES ACT* requires that every federal *FISHERY MANAGEMENT PLAN* (*FMP*) must be consistent with *NATIONAL STANDARD* 9 of the *MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT* (*MAGNUSON-STEVENS ACT*). National Standard 9 requires that "Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch." Section 303(a)(11) of the Magnuson-Stevens Act requires each FMP "establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the *FISHERY*, and include conservation and management measures that, to the extent practicable and in the following priority –

(A) minimize bycatch; and
(B) minimize the mortality of bycatch which cannot be avoided."

The proposed action is needed to (1) reduce waste, discard, and collateral damage to marine plants and animals by groundfish fishing activities on the Pacific coast, (2) collect and report appropriate and adequate information to support the groundfish fishery management program, and (3) balance these needs with environmental and social values (i.e., need to allow for fishing).

Words printed in *TYPE LIKE THIS* are defined in the glossary at the end of this document.

1.3 Purpose of the Proposed Action

As identified by the Council's ad hoc Environmental Impact Statement Oversight Committee (Committee), the purposes (objectives) of the proposed action include the following:

- **account for total fishing mortality by species**
- **establish monitoring and accounting mechanisms to keep total catch of each groundfish stock from exceeding the specified limits**
- **reduce unwanted incidental catch and bycatch of groundfish and other species**
- **reduce the mortality of animals taken as bycatch**
- **provide incentives for fishers to reduce bycatch and flexibility/opportunity to develop bycatch reduction methods**
- **monitor incidental catch and bycatch in a manner that is accurate, timely, and not excessively costly**
- **reduce unobserved fishing-caused mortalities of all fish**
- **gather information on unassessed and/or non-commercial species to aid in development of ecosystem management approaches**.

1.4 How this Chapter Is Organized

Chapter 1 identifies the issue of bycatch reduction and reporting as the focus of the proposed action and describes why the action is needed. Section 1.5 further clarifies the legal mandates and defines the term "bycatch" as it is used throughout this EIS. Council and NMFS actions relating to bycatch are described to help set the context for the proposed action. Section 1.6 describes the process used to identify the important environmental issues to be addressed by various alternatives. Previous Council and NMFS actions to reduce bycatch are described in Section 1.7. Section 1.8 identifies the criteria that will be used in selecting the agency preferred alternative. Section 1.9 describes the organization of this EIS and the steps to determine and evaluate the anticipated environmental impacts.

1.5 Background

The Magnuson-Stevens Act (16 U.S.C. §§ 1801-1884) was first enacted by Congress in 1976 and has been amended several times since then. The Magnuson-Stevens Act established

United States' fisheries jurisdiction over the *EXCLUSIVE ECONOMIC ZONE* (*EEZ*) (waters 3-200 miles offshore). It also established eight regional fishery management councils charged with developing fishery management plans for the areas under their respective jurisdictions. Fishery management plans are approved, implemented, and enforced by the NOAA Fisheries.

> Most groundfish are also known as "bottomfish" because they live on or near the sea floor.

The Pacific Council is responsible for fisheries in the EEZ off Washington, Oregon, and California. The Pacific Council has developed several fishery management plans, including the *PACIFIC COAST GROUNDFISH FISHERY MANAGEMENT PLAN* (Groundfish FMP). The Groundfish FMP was first implemented in 1982. It covers more than 80 species of groundfish, many of which are caught together on a variety of fishing gears that are used to target groundfish. Groundfish are also caught incidentally in fisheries for non-groundfish species such as pink shrimp and California halibut. As of January, 2004, nine groundfish species have been declared overfished. These are darkblotched rockfish, canary rockfish, lingcod, yelloweye rockfish, bocaccio rockfish, cowcod (also a rockfish species), widow rockfish, Pacific ocean perch (another rockfish), and Pacific whiting. Each of the overfished species is subject to a rebuilding strategy that constrains fishing for that species.

> The Groundfish FMP covers more than 80 species of fish, many of which are caught together by a variety of fishing gears that are used to target groundfish. Groundfish are also caught incidentally in fisheries for non-groundfish species.

A 1996 amendment to the Magnuson-Stevens Act, the Sustainable Fisheries Act, created numerous new requirements for fishery management plans. Among the new requirements was a requirement that fishery management plans "establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery, and include conservation and management measures that, to the extent practicable and in the following priority – (A) minimize bycatch; and (B) minimize the mortality of bycatch which cannot be avoided." 16 U.S.C. § 1853(a)(11). The Magnuson-Stevens Act defines the term "bycatch" to mean "fish which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic discards and regulatory discards. Such term does not include fish released alive under a recreational catch and release fishery management program." 16 U.S.C. § 1802(2).

To meet the new requirements imposed by the Sustainable Fisheries Act, the Pacific Council prepared Amendment 11 to the Groundfish FMP. Amendment 11 included bycatch provisions, but these were disapproved by NOAA Fisheries as

The bycatch provisions of the Groundfish FMP were "overturned" and sent back to NMFS and the Council. The FMP must be amended to comply with the bycatch management requirements specified in the Magnuson-Stevens Act.

inadequate, and returned to the Pacific Council for further work. The Pacific Council subsequently prepared, and NOAA Fisheries approved, another bycatch amendment (Amendment 13) to the Groundfish FMP. Amendment 13 attempted to comply with the bycatch requirements by providing that NOAA Fisheries could implement an observer program to gather data on bycatch, and could also take a variety of listed measures to reduce bycatch. Amendment 13 and its accompanying Environmental Assessment (EA) were subsequently disapproved by the federal district court as inadequate in Pacific Marine Conservation Council v. Evans, 200 F.Supp.2d 1194 (N.D. Calif. 2002) [hereinafter PMCC].

In PMCC, the court made several rulings with respect to the adequacy of the Amendment 13 bycatch revisions and the EA. The court held that Amendment 13 failed to establish a standardized reporting methodology because it failed to establish either a mandatory or an adequate observer program. Further, it failed to minimize bycatch and bycatch mortality because it failed to include all practicable management measures in the FMP itself. The court also found a lack of reasoned decisionmaking because four specific bycatch reduction measures (fleet size reduction, marine reserves, vessel incentives, and discard caps) were rejected without consideration on their merits. With respect to NEPA, the EA prepared for Amendment 13 failed to address adequately the ten criteria for an action's significance set forth in the CEQ regulations at 40 CFR 1508.27(b), and also failed to analyze reasonable alternatives, particularly the immediate implementation of an adequate at-sea observer program and bycatch reduction measures.

This EIS has been prepared as a programmatic document to assist the Pacific Council and NOAA Fisheries in taking the next steps necessary to meet the bycatch requirements.

This *ENVIRONMENTAL IMPACT STATEMENT* (EIS) has been prepared as a programmatic document to assist the Pacific Council and NOAA Fisheries in taking the next steps necessary to meet the bycatch requirements of the Magnuson-Stevens Act and to address the specific legal deficiencies identified by the court in the PMCC decision. When the EIS is final, the Council is expected to immediately undertake preparation of a new FMP amendment that will include the conservation and management measures necessary to minimize bycatch and to minimize the mortality of bycatch that cannot be avoided, to the extent practicable. This EIS is intended to provide the analytical underpinnings for that effort. In addition to other bycatch mitigation tools, it includes consideration of fleet size reduction, marine reserves, vessel incentives, and discard caps, as required by the PMCC decision.

The Council and NMFS adopted a mandatory observer program in Amendment 16-1 to the Groundfish FMP.

With respect to the requirement for a standardized reporting methodology, the Council and NMFS adopted a mandatory observer program in Amendment 16-1 to the Groundfish FMP. Amendment 16-1 was approved by NOAA Fisheries on November 14, 2003. Pre-existing regulations implementing the FMP already required fishing vessels to carry observers at the request of NOAA Fisheries. A mandatory observer program was begun under these regulations in August 2001 under the auspices of the Fishery Resource Analysis and Monitoring Division, Northwest Fisheries Science Center, NOAA Fisheries, Seattle, Washington. This program has continued and expanded since that time. Preliminary information obtained through the observer program is contained in the observer program's "Initial Data Report and Summary Analyses" dated January 2003, details of which are included in this EIS. The full report is provided as Appendix A. An updated report is expected to be available in time for inclusion in the final EIS.

In this EIS, "bycatch" means discarded catch of any living marine resource plus unobserved mortality that results from a direct encounter with fishing gear.

The Magnuson-Stevens Act generally defines "bycatch" as fish that are discarded for regulatory or economic reasons The term "fish" is defined to include nearly all types of marine life except marine mammals and seabirds. However, most fishery managers also use the term in a broader sense. The broader meaning sometimes includes fish, marine mammals and seabirds that are caught incidentally while fishing for a different species. It can also include fish of the same species that are small or inferior quality, or fish that simply co-occur in a particular fishing location and are caught together. Fish caught under these circumstances may either be kept or discarded. Problems presented by the overfished groundfish species, which frequently co-occur with other species, or are caught incidentally, are particularly difficult to solve. Consideration of these problems is also included in this EIS.

"Fish" means finfish, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds.

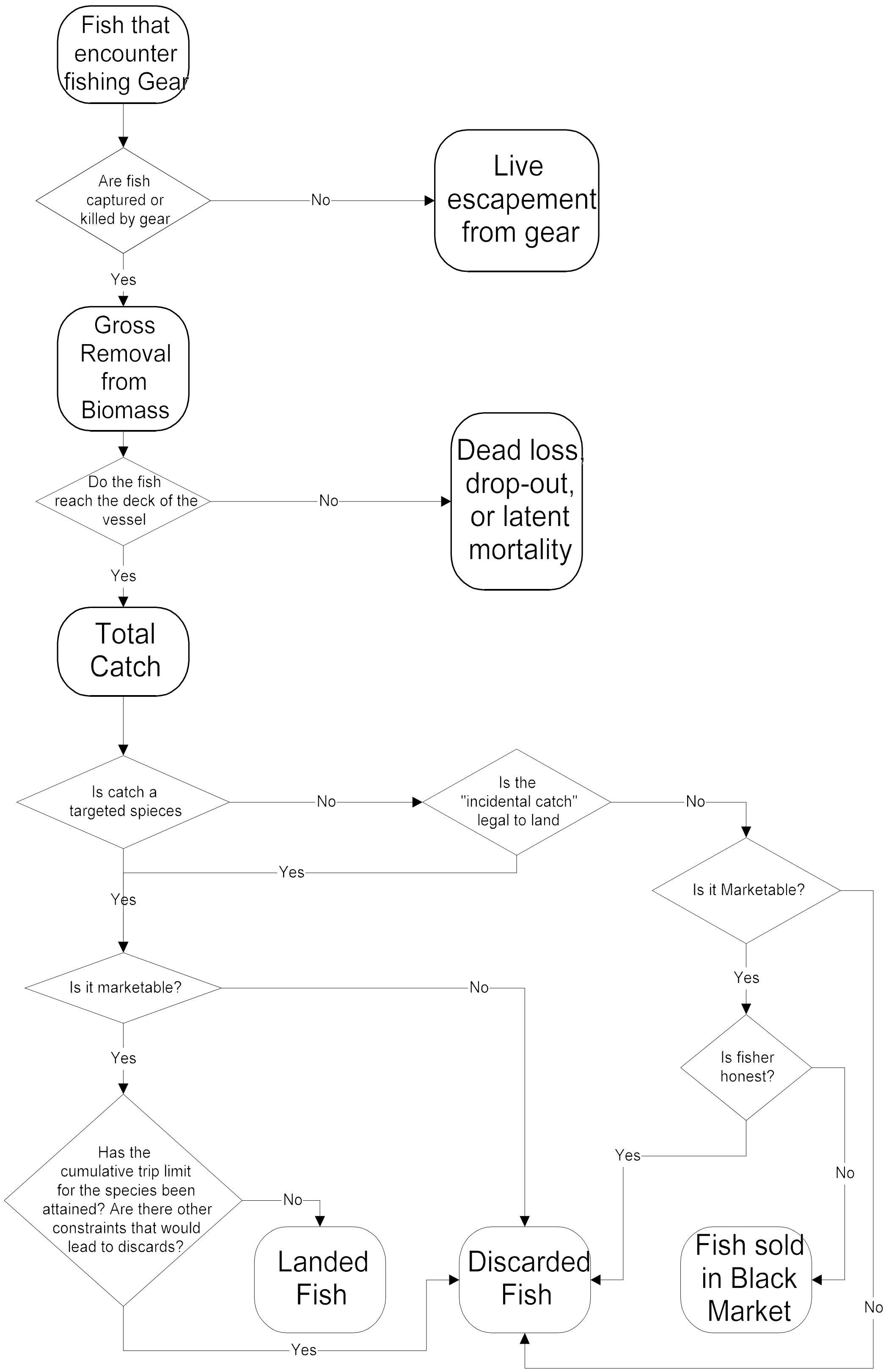
The Proposed Action is to establish bycatch management policies and program direction consistent with these mandates. Certain bycatch mitigation measures have been established; additional measures may be established based on decisions related to this PEIS. New bycatch mitigation measures may require additional NEPA analysis.

The bycatch management policies, reporting methodologies, and reduction measures make up a bycatch management program. "Bycatch," as the term is defined in the Magnuson-Stevens Act, refers specifically to fish. "*FISH*" is defined broadly to include nearly all species of marine organisms except seabirds and marine mammals; however, these non-target marine animals may also be affected by federally-managed fisheries, and impacts on them must also be considered in order to be consistent with other federal laws. Therefore, for the purposes of this *ENVIRONMENTAL IMPACT STATEMENT* (EIS), the term bycatch will mean discarded catch of any living marine resource, plus any unobserved mortality that results from a direct encounter with fishing gear.

The groundfish fishery off the West Coast of the United States is executed from the Canadian to Mexican borders. Multiple vessel types participate in this fishery. They range in size from 8' kayaks to 120' trawlers and fish in nearshore to offshore waters. The vessels use various types of gear including bottom trawls, midwater trawls, pots, longlines and other hook and line gear to catch over 80 species of marketable fish. Trawlers take the majority of groundfish. The catch can be incredibly diverse in species and fish size and overall catch size can vary widely as well. In many cases, a portion of the catch is retained and another portion of the catch, that may be of the wrong size, species, or is over management quota limits, is discarded at sea.

Figure 1.1 illustrates the meaning of bycatch and other catch-related terms as they are defined and used in the Magnuson-Stevens Act and Pacific Coast Groundfish FMP. Some fish encounter fishing gear but escape alive. However, there will almost always be some unobserved mortality resulting from injury when fish encounter fishing gear, especially mass-contact types of gear, such as trawl gear. The latent or "pass-through" mortality of fish escaping from a trawl net may be quite high depending on the design and manner in which the gear is fished as well as its mesh size (Henry 1990). Additional delayed mortality may occur after fish escape gear. This type of morality may be related to the stress of capture and physiological injuries which subsequently turn out to be fatal (Davis and Ryer 2003). There may also be mortality associated with gear that is lost or abandoned — the bycatch resulting from this "*GHOST FISHING*." NMFS considers this unobserved fishing-related mortality included in the definition of bycatch because it constitutes a harvest of fish that are not sold or kept for personal use (63 FR 24235 May 1, 1998).

Figure 1.1. Diagrammatic representation of bycatch and other catch-related terms.



"Bycatch concerns stem from the apparent waste that discards represent when so many of the world's marine resources either are utilized to their full potential or are overexploited. These issues apply to fishery resources as well as to marine mammals, sea turtles, seabirds, and other components of marine ecosystems." - *Managing the Nation's Bycatch*

"*TOTAL CATCH*" is that quantity taken by the fishing gear and which reaches the deck of the fishing vessel. It is sometimes useful to subdivide total catch into "targeted catch" and "non-targeted catch" (also referred to as "*INCIDENTAL CATCH*"), bearing in mind that a species can move from one category to another depending on size, market demand, season or other criteria.

A fish captured by a commercial fisher can be retained and sold or discarded; a fish captured by a recreational fisher can be retained or discarded, but may not be sold. In both cases, "discards" are that portion of total catch thrown away at sea (for one reason or another). The remainder is the "*LANDED CATCH*" or "retained catch" (i.e., that which is brought ashore).

There are circumstances in which fishermen will discard fish even though they are marketable or desirable. Discarding these fish may be the result of *FISHERIES MANAGEMENT MEASURES* directly, such as *PROHIBITED SPECIES* regulations or incentives created by management measures (e.g., a cumulative trip limit or quota constraint). Discarding may also occur for economic reasons (e.g., to make room in the vessel hold for more valuable catch) or for other non-regulatory reasons (e.g., recreational fisher doesn't like it). In most cases, fish that are not marketable because they are undesirable species, size, sex, or quality are discarded. Fish that are illegal to land (due to restrictions imposed by fisheries management) are in most cases discarded, although some of this fish may be retained by a recreational fisher or retained and sold on the black market commercial fishers (or recreational fishers), if these fishers have dishonest tendencies.

U.S. fishery policy in the 1970s and 1980s focused primarily on development of American fishing and processing capacity so the entire harvest could be used by U.S. citizens. Bycatch was considered to be mainly a social and economic issue; the main concerns were bycatch of *SALMON*, Pacific halibut, and high value groundfish taken by foreign TRAWL fishing operations targeting Pacific whiting, and catch of salmon and halibut taken by American trawl fishers. Foreign catch of Pacific ocean perch was considered a conservation issue because this species had been severely depleted by earlier foreign fishing. Bycatch of salmon and Pacific halibut by U.S. trawl fishers was also considered a problem because it could reduce the target fishery quotas for these species. (The International Pacific Halibut Convention prohibits the use of trawls to harvest halibut;

harvest of salmon with trawls is also prohibited in U.S. and Canadian waters. Dungeness crab is another prohibited species in most *COMMERCIAL* groundfish fishing operations.)

When certain salmon populations were listed as *THREATENED* or *ENDANGERED* under the *ENDANGERED SPECIES ACT* (ESA), NMFS evaluated the impact of the groundfish fisheries on these populations and prepared a series of *BIOLOGICAL OPINIONS*. Amendment 7 to the groundfish FMP acknowledged that groundfish fishing may directly impact non-groundfish species and authorized implementation of measures to control groundfish fishing to share conservation burdens to protect those stocks.

Marine plants and animals that occur in the same place may be captured together by some types of fishing gear.

The groundfish resource includes over 80 species of *FINFISH* that inhabit a wide variety of marine habitats. Many of these species occupy the same *HABITATS* and are caught together, either intentionally or unintentionally. While some species may be more desirable from a commercial or *RECREATIONAL* standpoint, fishing methods are rarely selective enough to catch only the most desirable species. Other *GROUNDFISH* species are typically caught incidentally, and many are considered valuable for human consumption, bait or other uses. This INCIDENTAL CATCH has always been considered a part of fishing, and fishers typically keep what they can use; bycatch (*DISCARD*) of groundfish is the portion of the catch that cannot be used, whether due to regulations, markets, or edibility (or palatability). Incidental catch and bycatch in the groundfish fishery were initially considered an unavoidable “cost of doing business.” The main concerns were the cost of sorting the catch, damage to more valuable fish, lack of storage space, or lack of markets. In fact, the original FMP defined the *OPTIMUM YIELD* (*OY*) to exclude all groundfish discarded by U.S. fishermen and fishing vessels. A single OY was established for the entire groundfish resource, defined as “all the groundfish that can be taken under the regulations, specifications, and management measures authorized by the FMP and promulgated by the *SECRETARY* (of Commerce).” This OY was not a predetermined or specified numerical amount, but rather whatever harvest (landed catch) resulted under the regulatory program and economic conditions. As U.S. harvesting capacity grew and exceeded sustainable harvest levels, retention limits were established for commercial fishing vessels to prevent excessive harvest of certain groundfish species. These vessel limits, called *TRIP LIMITS*, initially limited the amount of fish a vessel could catch and retain during a single fishing trip. Later, trip limits were applied to a period of time such as a week or two-week period; more recently the time periods were extended to monthly or two-month periods. Much of the management process each year is focused on monitoring the rate of commercial landings and adjusting trip limits to maintain a relatively consistent product flow throughout the year. This system requires commercial vessel operators to cull (discard) any catches that exceed specified limits. The system worked relatively well as long as trip limits were so large (tens or hundreds of thousands of pounds) that few vessels reached those limits. However, as various species were "fished down," trip limits were reduced correspondingly to the point where many vessels frequently reach the limits. Trawl gear designed to catch large amounts of fish often captures too much, especially late in a period when the vessel is trying to catch just enough to fill its limit. This problem became more acute as trip limits were established for more species, and as trip limits became smaller (for example, a few thousand pounds). Since 1999, with development of *REBUILDING PLANS* for *OVERFISHED* groundfish species, some trip limits have been reduced to a few hundred pounds. Fishers must now avoid these species as much as possible, although they may be allowed to keep some overfished species up to their limits.

"NEPA" stands for the National Environmental Policy Act. This federal law requires every federal agency to prepare an analysis of environmental effects before it takes a major action that may affect the environment. The agency must "specify the alternative or alternatives ... considered to be environmentally preferable" and "whether all practicable means to avoid or minimize environmental harm from the alternative selected have been adopted, and if not, why they were not."

Federal agencies are required to comply with the *NATIONAL ENVIRONMENTAL POLICY ACT* (*NEPA*) when a major federal action may be taken by an agency. Federal decision-makers are to use NEPA to assist them with making the appropriate decision for a *PROPOSED ACTION*, including fishery management plans and regulations. NEPA requires agencies, in this case the Council and NMFS, to consider reasonable alternatives to achieve the identified purpose and need, to evaluate the environmental consequences of the alternatives, and to provide for public participation in the decision-making process.

The proposed action is to amend the FMP and its implementing regulations to comply with section 303(a)(11) of the Magnuson-Stevens Act. Changes to the bycatch program may require revisions to the catch and bycatch reporting and monitoring systems and/or to conservation and management measures. In considering this action, the Council and NMFS will evaluate the effects of bycatch on other non-target species to ensure that fishery management does not result in conflicts with other legal mandates. This action is being undertaken to ensure the FMP complies with the conservation and management requirements of the Magnuson-Stevens Act , *MARINE MAMMAL PROTECTION*

ACT (*MMPA*), *MIGRATORY BIRD ACT*, Endangered Species Act (ESA) and other applicable federal laws.

This EIS analyzes the expected environmental impacts of various alternative methods to reduce bycatch.

This Draft PEIS addresses the issue of bycatch and other incidental catch in the Pacific Coast groundfish fishery. Specifically, this EIS analyzes the expected environmental *IMPACTS* of various alternative methods to reduce bycatch taken by commercial and recreational fishers fishing for groundfish and associated species and methods of collecting bycatch information.

Effective fishery management programs include several smaller programs such as stock assessment, policy and regulation development, decision-making, monitoring, information collection, and enforcement. These sub-programs must be designed, matched and integrated to achieve the overall program goals and objectives. The fishery management program established by the groundfish FMP is one of the most complex and complicated in the Nation, covering over 80 species over the entire West Coast of the U.S. Thousands of commercial fishing vessels harvest groundfish each year, and many more thousands of recreational fishers fish for many of the same species. The catching capacity ("fishing power") of each of these sectors far exceeds the capacity of many species to sustain themselves under that fishing pressure. Thus, regulations to limit catch have become more stringent and complex. Nine groundfish stocks have been classified as overfished, and efforts to rebuild them require that harvest be minimized to the extent practicable. Along with this, it is critical that rebuilding efforts be closely monitored to ensure the regulations are effective and catches are reduced as intended. In addition, effects of fishing on other fish, birds and marine mammals should be monitored and mitigated as appropriate.

Groundfish species are important components of the marine ecosystem off the Pacific coast of North America, and fishing for groundfish affects other components of the marine environment.

Groundfish species are important components of the marine *ECOSYSTEM* off the Pacific coast of North America, and fishing for groundfish affects other components of the marine environment. Non-groundfish species may be captured and/or killed directly by groundfish fishing gears or fishing methods. Even some groundfish species may be subjected to additional mortality, such as being captured and released. Groundfish fishing may reduce food sources (*FORAGE*) for other marine animals. In some cases, groundfish species may be the forage. In other cases, the forage may be other species that are affected by groundfish fishing.

HARVEST includes all fish that are captured, whether intentionally or not, and all fish that are killed, whether retained by the fisher. Fish that are captured and released or discarded are called bycatch. Bycatch also includes fish that are injured or killed but not captured (for example, "dropouts" and fish that become unhooked) and fish killed by lost and discarded gear (ghost fishing). In addition, groundfish fishing could directly or indirectly affect other marine animals such as marine mammals, seabirds and turtles. The EIS evaluates certain potential effects and could indicate the need for management measures to *MITIGATE* such impacts.

The current bycatch program includes a mix of indirect measures to control bycatch and a combination of methods to report and assess catch and bycatch amounts. Some management policies and measures tend to increase regulatory bycatch. Overall, the current bycatch program provides little individual bycatch accountability or opportunity or incentives for individuals to reduce bycatch.

1.6 Scoping: Key Issues and Development of Alternatives

Pacific Coast Groundfish EIS Scoping Hearings

2001

CITY	**DATE**
Newport, OR	May 22
Astoria, OR	May 23
Eureka, CA	May 29
Los Alamitos, CA	May 30
Seattle, WA	June 5
Burlingame, CA *(at Council meeting)*	June 12

2003

Foster City, CA *(at Council meeting)*	June 16

NEPA mandates that "[t]here shall be an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action." This process, termed scoping, allows the public to comment on what the EIS should cover in order to help determine possible alternatives, issues and impacts to be analyzed. The overall purpose of the scoping process is to identify the affected public, identify public and agency concerns, define issues that will be examined, and assign EIS preparation tasks.

The scope of this EIS has been refined since NMFS initially identified a need for action, and NMFS conducted two scoping processes relating to this EIS. The first scoping process, from April 10, 2001 through June 12, 2001, focused on the need for a Programmatic EIS (PEIS) on the entire Pacific Coast groundfish fishery management program. NMFS published an initial scoping report in August 2001 which provided a summary of all comments received and key issues identified during the scoping process. Bycatch was a major issue identified during scoping, along with protection of essential fish habitat (EFH) and several other issues. NMFS immediately began working with the Council to develop alternatives to address the purpose and need for the PEIS. In February 2002, NMFS determined there was a need to address EFH issues independently and began preparation of a separate EIS focusing specifically on designation of essential fish habitat (EFH) and associated management measures, including measures to reduce effects of fishing on EFH. This separation was intended to improve public understanding and participation in the NEPA process, to make each EIS more useful in future management decisions, and to more clearly distinguish between programmatic groundfish fishery management and specific EFH issues. On May 16, 2003, NMFS published a notice of its intent to further revise the scope of the PEIS; the intent was to focus more specifically on issues relating to bycatch reduction and monitoring.

The Council established an ad hoc Groundfish EIS Oversight Committee (Committee) to advise the drafting team and help develop a range of programmatic alternatives for managing the Pacific Coast groundfish fishery. The Committee, at its third meeting (April 22-23, 2003), reviewed the status of the PEIS, the alternatives under consideration, events subsequent to the initial scoping period. Based on its perception that conditions and needs had changed and on NMFS comments, the Committee recommended the scope of the EIS be focused more narrowly on the more pressing issue of bycatch reduction and reporting. The Committee prepared a revised set of alternatives to encompass the range of approaches to reduce bycatch and to address incidental catch monitoring and reporting issues. NMFS reopened scoping and conducted an additional scoping meeting on June 16, 2003 in conjunction with the Council meeting in Foster City, California. These alternative were presented to the Council at its meeting, along with a summary of comments received during the second scoping period. The Council provided comments in concurrence with the revised scope and suggested improvements to the alternatives its committee had prepared. NMFS has adopted those alternatives in this EIS.

1.6.1 Key Issues Identified During Initial Scoping Period

Time/Area Management

- Year-round fishery policy versus partial year fishery
- Traditional single-species management versus an ecosystem-based approach

Fleet Capacity

- Capacity reduction consistent with number of fish available
- Geographic distribution of vessels under capacity reduction
- Active reduction of the fleet versus establishing methods for the industry to reduce itself
- Overcapacity is too narrow an issue for an option in EIS analysis
- Effects of capacity reduction on the value and need for MPAs

Resource Allocation

- Promote IFQs/ITQs
- Consider whether flexibility of ITQs will harm coastal communities
- Keep effort/people spread along coast
- Consider port quotas, like CDQs and Cooperatives, for West Coast communities
- Allow permit transfers between gear types in the limited entry program
- Allocate resource equitably between recreational and commercial sectors
- Coordinate inshore species allocation for recreational and commercial sectors with States
- Consider gear impacts and efficiency during allocation (favor low impact, less efficient gear)
- Allocate catch to particular vessels rather than gear types based on "clean" fishing practices (low bycatch, minimal habitat disturbance by gear)

Bycatch/Discards

- Bycatch and discards created by regulations
- Analyze year-round fishery for bycatch/discards
- Verify effectiveness of time/area management as a bycatch reduction measure
- Higher limits would reduce discards
- Standardize a reporting method for bycatch by having fishers provide bycatch information in logbooks
- Lack of data on discards (number, type, mortality)
- Lack of research on bycatch-friendly gear; hook-and-line fishery has no bycatch
- Create incentives to reduce bycatch
- Reduce waste: use bycatch/discard overages instead of throwing them away
- Recreational fishery should increase efforts to help discarded fish survive, especially undersized fish

- Reevaluate bycatch estimates for fisheries
- Use bycatch caps to close target fishery
- If it's legal for you to sell, it's not bycatch
- Ocean ecosystem linked tighter than land ecosystem, therefore if protein taken out, effects felt elsewhere

Gear

- Lack of data on relative selectivity of gear
- Favor more selective gear types
- Evaluate gear performance standards vs. design standards

Gear restrictions:

- Create incentives/penalties rather than mandating gear changes/restrictions
- Do not ban gear
- There must be a better way to protect red rockfish than requiring small footropes
- Prohibit "rockhopper" gear
- Evaluate effectiveness of small footrope requirement

1.6.2 Key Issues and Comments During Second Scoping Period

Substantial support remains for a programmatic EIS for the broader groundfish management program.

The second scoping period focused primarily on whether to refine the scope to focus more narrowly on bycatch or to continue with the broad scope of the entire groundfish fishery management program. Support for the broad scope was expressed, along with need for specific bycatch reduction measures at the end of this NEPA process. Methods to improve bycatch avoidance were stressed, and development of incentive-based measures. While increased observer coverage was widely endorsed, concerns about cost and cost-effectiveness were also expressed. No new issues were identified beyond those identified in the initial scoping process.

1.7 The Groundfish Fishery Management and Bycatch Mitigation Program

The original groundfish FMP did not include discarded groundfish in the definition of OY.

Active management of the domestic groundfish fishery began in the early 1980s with the establishment of numerical Optimal Yields (OYs) for several managed species and trip limits for widow rockfish, the *SEBASTES COMPLEX*, and sablefish. The objective of trip limits was to slow the pace of landings to maintain year-round fishing, processing, and marketing opportunities. Since the 1980s, management regulations generally have evolved to the use of cumulative 2-month catch limits.

Bycatch and discards can result from a regime of multiple trip limits because a fisher might target gear on a complex of species, and then find that in order to catch the full limit on one species, he has to exceed the limit on other species, and then discard that excess.

Initially, trip limits were "per trip" limits.

Under the original groundfish FMP, most groundfish were included in a non-numerical OY that excluded bycatch. The non-numerical OY was defined as "all the fish that can be taken under the regulations, specifications, and management measures authorized by the FMP and promulgated by the U.S. Secretary of Commerce. This non-numerical OY is not a predetermined numerical value, but rather the harvest that results from regulations..." In short, OY included all groundfish legally caught and landed. This definition was based on the understanding the groundfish fishery is a multi-species fishery, with multiple fishing strategies and target strategies. Almost all domestic groundfish bycatch in the early years of groundfish management was market-induced discards, where fishers were throwing away unmarketable species or unmarketable sizes of targeted species. Domestic fisheries management did not account for these groundfish discards; targets for landed catch were set equal to the *ACCEPTABLE BIOLOGICAL CATCH* (*ABC*). For the foreign and joint venture fisheries, the Council set incidental catch limits for non-target species.

Over time, foreign and joint venture fisheries dwindled, and the Council introduced trip limits for a greater number of species taken in the domestic fisheries. *EFFORT* increased in the domestic fishery, and trip limits became more restrictive to control harvest rates. The Council realized that managing a variety of species under trip limits could lead to increased rates of discards for some species. Bycatch and discards can result from a regime of multiple trip limits because a fisher might target gear on a complex of species, and then find that in order to catch the full limit on one species, he has to exceed the limit on other species, and then discard that excess. To address this issue, the Council shifted away from per trip limits for most species and towards monthly cumulative limits. Cumulative limits were preferable to per trip limits because a fisher could accumulate species at different rates over different trips, without having to discard fish each trip because of exceeding per trip limits. Once the Council had seen that monthly landings limits would continue to allow a year-round fishery, it introduced two-month cumulative limits to again reduce the likelihood that fishermen would have to discard overages of particular species within a multi-species complex fishery.

Under cumulative limits, fishers can accumulate species at different rates over different trips, without having to discard fish each trip because of exceeding per trip limits.

The minimum mesh size in bottom trawls is 4½ inches. This reduces bycatch of juvenile and other small fish that would be discarded as unmarketable.

In addition to modifying the use of trip limits to reduce discards, the Council used other regulatory measures to reduce incidental catch of *JUVENILE* fish that would be discarded as unmarketable, and to reduce bycatch of protected salmon species. During the mid-late 1980s, the Council endorsed two research projects that addressed bycatch in the groundfish trawl fishery and potential mesh changes that might reduce bycatch of certain groundfish.[1/] The research was included voluntary observer programs, primarily on trawl vessels fishing off Oregon. In the early 1990s, the Council began responding to the preliminary results by requiring larger (4½ inch minimum) trawl mesh in net *CODENDS* and then requiring the larger mesh throughout *TRAWL* nets. By 1995, all bottom trawl nets were required to have a minimum of 4½ inch mesh, the use of chafing gear was restricted, and double-walled (lined) codends were prohibited (60 FR 13377, March 13, 1995, codified at 50 CFR 660.322). All of these measures were intended to give smaller-size fish the opportunity to escape from the trawl net, reducing the likelihood that those fish would be caught and discarded.

Reducing bycatch of threatened and endangered salmon species was particularly important to the Council as American fishers replaced the foreign whiting fishery in the late 1980s. The Council brought salmon and whiting fishers together to address salmon bycatch in the whiting fishery. In 1993, the Council established Klamath River and Columbia River salmon conservation zones and Eureka area trip limit restrictions to prohibit or reduce whiting fishing in areas of high salmon interception rates (58 FR 21261, codified at 50 CFR 660.323). The whiting fleets now also work to keep their chinook salmon interception below a voluntary threshold of 0.05 chinook salmon per metric ton of whiting.

> In the early 1990s, the Council sought to reduce at-sea catch of protected salmon stocks to soften management restrictions for the directed salmon fisheries. The Council brought salmon and whiting fishers together to develop salmon bycatch standards, area closures other recommendations for the whiting fishery.

Growth of the West Coast groundfish fisheries and inadequate scientific information combined to frustrate efforts to stabilize the management program and maintain stocks near MSY levels. While the Council was experimenting with these methods to reduce bycatch, domestic fishing capacity in the groundfish fleet was growing and outstripping resource productivity. We now also know that stock assessment information in the 1980s and early 1990s was not adequate to draw a clear picture of West Coast rockfish productivity. Harvest rates were based on scientific information available at the time are now considered too aggressive for *SUSTAINABLE* harvest on the very low productivity West Coast rockfish stocks (Myers, et al, 1999;

1/ Pikitch et al, 1988; Pikitch 1990; Bergh et al., 1990: Two voluntary observer programs (1985-1990) assessed discard causes and the impact of potential changes in codend mesh-size and shape.

Ralston et al, PFMC, 2000). The combination of increasing fishing capacity and decreasing OYs led to ever more restrictive cumulative landings limits. The Council's *GROUNDFISH MANAGEMENT TEAM* (*GMT*) became concerned about the effects of a restrictive cumulative landings limit regime on rates of bycatch and discard, and announced in April 1990 its plans to begin to factor discards into setting ABCs for the 1991 fishing year (PFMC GMT, 1990). In August 1990, the Council finalized Amendment 4 to the FMP, which introduced the practice of distinguishing between ABCs and *HARVEST GUIDELINES* to, among other things, account for fishing mortality beyond landed catch numbers (PFMC, August 1990.)

Amendment 4 set the Council's bycatch policies for the early-mid 1990s, accounting for discards by setting landed catch limits below ABC levels. Initially, only sablefish and Dover sole were managed with reduced landed catch limits. Over time, however, the Council treated a suite of rockfish and roundfish in a similar fashion by assuming a certain level of discard and subtracting that discard off allowable total harvest levels for each species. For rockfish species, discards were assumed to be 16% of the ABC. This assumption was based on a 1988 study (Pikitch, et al, "An evaluation of the effectiveness of trip limits as a management tool") that observed a 16% discard of widow rockfish in the trawl groundfish fishery (57 FR1654, January 15, 1992).

Over 1995-1998, Oregon Department of Fish and Wildlife (ODFW) administered the Enhanced Data Collection Project (EDCP) in cooperation with the states of Washington and California. The primary goal of the EDCP was to collect data on discard rates for groundfish species and to determine bycatch rates for prohibited species (salmon and Pacific halibut). Trawl catcher vessels participated in this program on a voluntary basis, carrying observers and/or logbooks. Trawlers used the logbooks to record discard and landed catch data, while observers additionally monitored quantities and rates of discards, species composition of discards, halibut viability information, and conducted some biological sampling.

NMFS declared three species overfished in 1999 – bocaccio, lingcod, POP. The first groundfish rebuilding measures were implemented as part of the 2000 specifications and management measures. These measures included: time/area closures to protect lingcod during their spawning/nesting season; limiting directed fishing effort on healthy species that co-occurred with overfished species to times and areas when the healthy stocks were most concentrated, or when bycatch of other species was expected to be low; setting cumulative landings limits to move fishing effort away from the deeper continental shelf, the primary habitat of several overfished species; and, setting differential landings limits for trawlers operating with different trawl gear configurations (bottom trawling with *FOOTROPES* greater than 8 inches in diameter, bottom trawling with footropes smaller than 8 inches in diameter, and *MIDWATER* or *PELAGIC TRAWLING*.) Trawling with footropes that have roller gear or other devices designed to bounce over rough rock piles tends to allow those vessels greater access to prime rockfish and lingcod habitat. Therefore, landings of *SHELF* rockfish were prohibited if large footrope trawls (roller gear) were used. Small amounts of shelf rockfish bycatch were allowed to be landed if small footrope trawls were used, and targeting healthy shelf rockfish stocks was encouraged only if midwater trawls were used.

In addition to these initial measures to reduce bycatch of overfished species, the Council began to incorporate information from analyses of the EDCP data into its management program for deepwater species. Methot et al. (2000) had used the data to estimate discard of sablefish, Dover sole, and thornyheads. Wallace and Methot (2002) also applied the data to estimate Pacific halibut bycatch mortality in IPHC Area 2A. Sampson (2002) applied the data to estimate average discard rates for the major species and determine the factors contributing to variability of discard rates. These analyses were used to set trawl cumulative landings limits for the "*DTS COMPLEX*," which were based on catch ratios between the four species in the complex–Dover sole, thornyheads (shortspine and longspine), and sablefish.

Three major objectives of the current bycatch mitigation program are: (1) improving the monitoring of bycatch, (2) improving the models used to quantify bycatch, and (3) implementing management measures to reduce bycatch.

Over 2000-2002, NMFS declared six additional species as overfished – canary rockfish and cowcod (2000), darkblotched and widow rockfish (2001), Pacific whiting and yelloweye rockfish (2002). West Coast groundfish management has been radically changed by the need to manage a group of multi-species fisheries to protect these nine overfished groundfish species. Reducing incidental take of overfished species has been one of the major goals of the rebuilding programs for overfished species. The Council's current bycatch mitigation program is separable into three major objectives: improving the monitoring of bycatch, improving the models used to quantify bycatch, and implementing management measures to reduce bycatch.

NMFS began placing observers onboard vessels participating in the shore-delivery groundfish fisheries in August 2001.

To improve bycatch monitoring, NMFS began placing observers onboard vessels participating in the shore-delivery groundfish fisheries in August 2001. This observer program, the West Coast Groundfish Observer Program (WCGOP) is distinct from the observer program for at-sea whiting fisheries, but both are managed out of the NMFS Northwest Fisheries Science Center. The focus of WCGOP is to collect total catch and discard data (including protected resources and seabirds) from commercial groundfish trawl and non-trawl gear (longline, pot, etc.) vessels. Observers in this program collect species composition of the discard and data on target fisheries interactions with species of concern. This observer program initially targeted the trawl and non-trawl limited entry fleets for observer coverage. Next, the program plans to expand its data collection efforts to assess catch and bycatch in the open access fisheries that target groundfish. The WCGOP is described more fully later in this document and Appendix B of this PEIS provides the full description of the first year program results: ***Northwest Fisheries Science Center West Coast Groundfish Observer Program - Initial Data Report and Summary Analyses***.

NMFS has developed a model for estimating incidental catch rates and amounts of several overfished stocks.

To better quantify bycatch, the Council needed updates to historical bycatch models. In late 2001, NMFS developed a model for estimating incidental catch rates and amounts of several overfished stocks taken in the trawl fishery. Because data from the new observer program was not yet assembled and available for use in the bycatch model, the initial bycatch model relied upon trawl logbooks and data from the EDCP program to estimate co-occurrence ratios between overfished and more abundant stocks. In 2002, NMFS expanded its “bycatch model” to facilitate Council consideration of depth-based management restrictions. The first year of WCGOP data (August 2001 - August 2002) was available by January 2003 and the bycatch model underwent a formal review by the Council’s Scientific and Statistical Committee. During 2003, NMFS revised the bycatch model to address the SSC’s concerns and presented the updated model to the Council in June 2003 for use in developing its 2004 harvest specifications and management measures. This latest version of the bycatch model estimates discards of both overfished and more abundant stocks. NMFS expects to further refine the model during 2004 to incorporate the second year of observer program data (September 2002 -

August 2003), which had a greater focus on the limited entry non-trawl fisheries than the first year of the program.

NMFS has implemented numerous management measures to reduce bycatch since 2000.

NMFS has implemented numerous management measures to reduce bycatch since 2000, most of which have been intended to protect and rebuild overfished species. NMFS and the Council have supported full retention or full utilization Exempted Fishing Permit (EFP) programs for the Washington arrowtooth flounder trawl, yellowtail rockfish trawl and longline dogfish fisheries, and for the California flatfish trawl fishery. Shorter-than-year-round fishing seasons have been set for various species and sectors of the groundfish fleet in order to protect different overfished groundfish species. Amendment 14 to the FMP implemented a permit stacking program for the limited entry fixed gear fleet that reduced the number of vessels participating in the primary sablefish fishery by about 40%. In 2003, NMFS implemented a buyback of limited entry trawl vessels and their permits, reducing the groundfish trawl fleet by about one-third. As discussed above, NMFS has implemented gear modification requirements that restrict the use of trawl gear in rockier habitat and other requirements to constrain the catching capacity of recreational fishing gear. Higher groundfish landings limits have been made available for trawl vessels using gear or operating in areas where overfished species are less likely to be taken. And, since late 2002, the Council's bycatch mitigation program has included a series of marine protected areas known collectively as groundfish conservation areas or rockfish conservation areas (RCAs). These large time/area closures affect the entire West Coast and are specifically designed to reduce the incidental catch of overfished groundfish species in fisheries targeting more abundant stocks. (RCAs). These were described in detail in the ***Final Environmental Impact Statement for the Proposed Groundfish Acceptable Biological Catch and Optimum Yield Specifications and Management Measures: 2003 Pacific Coast Groundfish Fishery***.

1.8 Selecting and Implementing the Agency Preferred Alternative

The Council and NMFS will consider how each alternative addresses the purpose and need for action (see sections 1.1, 1.2 and 1.3). They will weigh the expected or potential benefits and costs of each alternative and decide which, if any, alternative, provides the optimal balance. While six alternatives have been proposed, there are a variety of management measures that could be included (or excluded) from any alternative. The Council and/or NMFS may find that by revising an alternative they may be able to achieve greater benefits or better mitigate anticipated negative effects. Finally, the Council and NMFS will determine if and how each alternative reduces bycatch to the extent practicable and, for bycatch that cannot be avoided, reduces bycatch mortality to the extent practicable.

The Council reviewed a preliminary draft of this PEIS at its November 2003 meeting. The Council will review the Draft PEIS during the comment period and identify its preferred alternative at its April 2004 meeting. NMFS will make its decision based on the analysis of impacts, the Council's recommendations, public comments received on the Draft PEIS, and any other relevant information available. A Final PEIS will be prepared that responds to public comments received on the DPEIS, identifies the final Agency preferred alternative, and provides the rationale for NMFS' final decision. The alternative that is determined to be the "environmentally preferred" may or may not be same as the final preferred alternative. Any difference will be clearly explained.

1.9 How This Document is Organized

This EIS follows the standard organization established by the CEQ regulations. Chapter 1 has identified the issue of bycatch reduction and reporting as the focus of the proposed action and describes why action is needed. Previous Council and NMFS actions relating to bycatch are described to help set the context for the proposed action. Chapter 1 also lays out the criteria the Council and NMFS will use for making their final decision.

Chapter 2 presents the six alternatives to reduce bycatch and bycatch mortality, and to establish a standardized reporting methodology. It describes how the alternatives were developed, and provides a summary of the anticipated environmental impacts of the each alternative. It briefly describes the management "tools" available to the Council and NMFS for reducing bycatch and for monitoring the effects and effectiveness of the various tools, and how the alternatives apply the tools. It identifies the direct, indirect and cumulative impacts so the decision-makers can make a reasoned and informed decision, and the public can understand the conclusions and how they were reached.

Chapter 3 describes the affected environment as it pertains to incidental catch, bycatch, bycatch mortality, and catch reporting/monitoring. The factors related to bycatch are identified and described: co-occurrence in time and space; species behavior; fish body size and shape; and types of fishing gears and methods used. Chapter 3 describes the current human environment as it relates to incidental catch, bycatch and bycatch mortality. The current condition of particularly important groundfish and other species of marine animals are described, and how they are directly affected (that is, bycaught) in groundfish fisheries. The social and economic conditions relating to bycatch, bycatch reduction methods, and bycatch monitoring are also described.

Chapter 4 presents the analysis of environmental impacts. This chapter describes the capture methods of the various fishing gears, including selectivity features and placement factors (that is, where and in what conditions they can be used). Potential mitigation tools are described, that is, the available management measures and adjustments to control incidental catch and bycatch and to achieve other objectives. Regulations not related to fishing gears are identified and described: harvest specifications, allocation, retention limits, catch/ mortality limits, time/area management, limiting access (reducing fleet size), and data reporting/monitoring requirements. Collectively, these management measures are identified as the bycatch "mitigation toolbox." Potential effects of each tool are described and the effects and effectiveness of each tool are ranked. Next, the particular application of each tool, as it is used in each alternative, is ranked. This stepwise process provides the basis for modifying any alternative to better achieve the intended goals, taking into account the costs associated with any changes. There is no preferred alternative at this time. Effects of each alternative on groundfish, other important fish, seabirds and mammals are described.

Chapter 5 reviews the consistency of the alternatives with the goals and objectives of the groundfish FMP and the National Standards of the Magnuson-Stevens Act.

Chapter 6 describes the relationship between the proposed action and other federal laws and policies.

2.0 Alternatives, Including the Status Quo

Words printed in *THIS TYPE* are defined in the glossary at the end of this document. Other words are also defined.

The "bycatch mitigation toolbox" describes all the management measures (fishing regulations) that can be used to reduce bycatch to the extent practicable, and unavoidable bycatch mortality to the extent practicable.

2.1 Introduction

2.1.1 How this Chapter is Organized

Chapter 2 presents the alternatives that have been developed to resolve bycatch issues and to ensure the FMP complies with the bycatch reduction mandates of the *MAGNUSON-STEVENS ACT*. Each *ALTERNATIVE* describes a *BYCATCH* management program and includes all the parts of the program: the overall objectives, the methods to achieve the objectives, and the reporting and monitoring requirements that would be required. The six alternatives represent a variety of policies, approaches, and methods to reduce bycatch. The alternatives range from the current (2003) methods of reducing bycatch (Alternative 1, the status quo) to more aggressive and comprehensive bycatch reduction policies and methods.

Section 2.1.1 presents the bycatch mitigation "*TOOLBOX*," that is, the variety of regulatory measures available to the *COUNCIL* and Agency to implement a bycatch monitoring, reporting and reduction program. Each tool is described in terms of its usefulness, effectiveness, practicability, effects, etc. Not all of the available tools have been used to manage the Pacific *GROUNDFISH* fisheries.

Section 2.1.2 describes how the alternatives are structured so they can be compared and understood more clearly.
Sections 2.2.1-2.2.6 describe each alternative in detail. Section 2.3 summarizes the anticipated effects or impacts of each alternative in comparison to current conditions.

2.1.2 Available Management Measures (The "Bycatch Mitigation Toolbox")

A variety of management measures are used for controlling the West Coast groundfish fishing activities to ensure sustainable groundfish resources, habitats and fisheries (Table 2.1). Many, but not all, are specifically intended to mitigate bycatch or other unintended or unnecessary effects of fishing. Even if not intended as mitigation measures, most management tools have either beneficial or adverse consequences relating to bycatch. The fishery management tools include harvest limits, restrictions on fishing gears and fishing locations, reporting requirements and species *RETENTION LIMITS*. They are the tools for managing groundfish *HARVESTS*. In this EIS, these

Table 2.1. Bycatch Mitigation Tools

Harvest Levels
- ABC/OY
- sector allocations
- trip (landing) limits
- catch limits
- individual quotas

Discard Caps (limits and prohibitions)

Gear Restrictions
- **Trawl**
  - mesh size
  - footrope diameter/length
  - net height
  - codend mesh and dimensions
  - design: on-bottom or pelagic
  - bycatch reduction devices (BRDs)
- **Line**
  - number of hooks
  - hook size
  - line length
  - retrieval requirements
- **Pot/trap**
  - number of pots
  - pot size
  - escape panel in net/pot
  - retrieval requirements
- **Other**
  - setnets (gill and trammel nets)

Time/Area Restrictions
- seasons
- area closures
- depth closures
- marine reserves

Capacity (number of participants)
- permits/licenses/endorsements
- limited entry

Capacity (Vessel Restrictions)
- vessel size
- engine power
- vessel type

Monitoring/Reporting Requirements
- permits/licenses
- registrations
- Fish tickets (commercial landings/ sales receipts)
- Vessel logbooks
- Surveys
- Punch cards/tags (recreational)
- Port sampling/on-shore observers
- On-board observers
- Vessel monitoring systems (VMS)
- Onboard video recording devices
- Enforcement

management tools are collectively described as the "toolbox" which is available to the Council and NOAA Fisheries. Not all of the available tools are used for managing the groundfish fishery. The decisions about which tools to use or not use have been made over a number of years to address the variety of problems and issues that have come up. The main categories of tools in the toolbox are harvest level specifications, gear restrictions, time/area restrictions, capacity restrictions, and reporting/monitoring requirements.

Most management measures affect bycatch directly or indirectly; some tend to reduce bycatch, and some tend to increase bycatch. Chapter 3 of this EIS provides an evaluation of the relative *EFFECTS* and effectiveness of the various tools for reducing bycatch and fulfilling the bycatch reporting requirements specified in the Magnuson-Stevens Act.

2.1.3 Structure of the Alternatives

Each alternative includes general goals and/or objectives and the management tools to achieve them. Five alternatives to the *STATUS QUO* have been developed to provide a range of approaches to reducing bycatch and incidental catch. Some alternatives are more comprehensive than others, representing a different balance between regulatory burden, costs and other considerations. Some provide more information than others, thus reducing some of the uncertainty about status of groundfish stocks, *ECOSYSTEM* condition, and management program effectiveness. Some alternatives are more costly and less practicable than others, both to fishers and to the management agencies (both state and federal). The alternatives have been structured to clearly show the *IMPACTS* (effects) of different management approaches and combinations of management tools.

2.2 The Alternatives

Table 2.2 at the end of this section identifies the bycatch mitigation tools included in each alternative.

2.2.1 Alternative 1: No Action (The Status Quo)

Alternative 1 reduces incidental catch and bycatch through a combination of indirect measures: Optimum Yield (OY) specifications, area closures, gear restrictions, trawl fleet reduction, variable trip limits and bag limits, seasons and other measures. High priority is given to minimize cost of catch monitoring. Vessel trip limits are calculated using a computer model and incidental catch ratios from past years.

The status quo minimizes bycatch through a combination of *OPTIMUM YIELD* (OY) specifications, gear restrictions, area closures, variable *TRIP LIMITS* and *BAG LIMITS*, seasons and other measures, while minimizing cost of bycatch monitoring. The primary focus of this bycatch program is groundfish species. Negative *INCENTIVES* include requirements to sort groundfish catches into established categories (species or species group), discard *PROHIBITED SPECIES* (salmon, halibut, Dungeness crab), and discard all groundfish that exceed the trip (retention) limits. In addition, estimated bycatch mortalities are deducted from the annual allowable catch levels. Positive incentives include larger trip limits in areas where encounters with *OVERFISHED* species are expected to be low. In addition, a sablefish species *ENDORSEMENT* has been established for limited entry *FIXED-GEAR* vessels, along with *PERMIT STACKING*, individual permit sablefish catch allowances, and a longer season, which greatly reduces the "*RACE FOR FISH*" that occurred in past years. In the Pacific whiting fishery, OY is allocated among four sectors and vessels voluntarily practice bycatch reduction methods that focus on salmon as well as incidental catch of certain groundfish species.

The current bycatch management program uses indirect measures such as setting an overall OY (catch limit) for various groundfish species and, in some cases, sub-limits or *ALLOCATIONS* for each fishery *SECTOR*. A variety of measures such as area closures, seasons, gear modifications, etc., are established to ensure groundfish catches do not exceed the specified limits.

Since 1998, groundfish management measures have been shaped by the need to rebuild overfished groundfish stocks. There are more than 80 species in the West Coast groundfish complex, and many of these species co-occur to different degrees in different areas. Each species has its own habitat "affinity" associated with depth, substrate, temperature, portion of the water column, etc. Some have fairly restricted distributions, while others are widespread. Over the past several years, groundfish management measures have been more carefully crafted to recognize the tendencies of overfished species to co-occur with healthy stocks in certain times and areas.

In 2000, the Council refined the management program on the understanding that certain types of *TRAWL* gear cannot be effectively fished in areas where the seafloor is rocky or uneven. Specifically, only *BOTTOM TRAWLS* with large diameter *FOOTROPES* can pass along this type of seafloor without snagging or hanging up on the multitude of obstructions. Use of large footrope trawls was not prohibited, but trip limits were set at such small levels that the economic incentives favored small footrope gear. Allowances were made for use of large footrope gear for deepwater stocks found primarily outside the range of most overfished species. In 2002 the Council introduced a new "bycatch" analysis model that allowed managers to set trip limits so that more abundant stocks were strongly *TARGETED* in times when they were less likely to co-occur with overfished stocks. The 2002 management measures primarily varied by time (two-month period) and by north-south management area (north of Cape Mendocino, between Cape Mendocino and Point Conception, south of Point Conception, etc.). Beginning in late 2002, the Council began using depth-based area restrictions. These area restrictions are intended to prevent vessels from fishing in depths where overfished species commonly occur, while still allowing some fishing for more abundant stocks in the open areas. The inner and outer boundaries of these closed areas may be adjusted seasonally; the boundaries may be expanded during periods when overfished stocks are distributed more widely. Conversely, the boundaries may be narrowed when the overfished species are more concentrated or to allow access to other stocks that are more available at certain times. Different closed areas are provided for different gear types, as not all gear types encounter each overfished species at the same rate or in similar areas.

Participation in the *COMMERCIAL* groundfish fisheries is limited by a federal permit system established in 1994. This program limited the number of trawl, *LONGLINE* and *POT* (fish trap) permits and established a number of conditions and requirements. Each permit specifies the type of gear the vessel may use to participate in the limited entry fishery, and the vessel length associated with the permit. A vessel may only participate in the fishery with the gear designated on its permit(s) and may only be registered to a permit appropriate to the vessel's length. Since 1994, the Council has modified license restrictions for the *LIMITED ENTRY* fixed gear (longline and fish pot gear) to allow vessels to accumulate ("stack") and use as many as three sablefish-endorsed permits during the primary sablefish fishery.

The number of trawl permits was reduced in the mid-1990s when seven large *FACTORY-TRAWL* vessels purchased and consolidated a number of permits in order to participate in the Pacific whiting fishery. A federally-supported trawl *BUY-BACK* program is being developed in 2003 to further reduce the number of permits. NMFS has reported that 108 individuals submitted bids to participate in the buy-back program. Of these, 92 have been accepted as successful bidders. These 92 vessels account for 35% of all of the groundfish trawl permits. During the 1998 - 2001 base years, these vessels accounted for 36.5% of the trawl-caught groundfish, including whiting. They accounted for 46% of all the non-whiting groundfish during that period. In addition to removing groundfish trawl permits, this program also requires the retirement of Dungeness crab and pink shrimp permits as well. Vessels remaining in the fishery would pay the costs of the reduction program.

Certain gear types and fisheries were exempted from the limited entry program and remain "*OPEN ACCESS*." Trip limits for these vessels are set to allow retention of incidentally-caught groundfish and limited intentional groundfish harvest.

Recreational fisheries off Washington, Oregon, and California are managed by a combination of bag limits, gear requirements, size limits, seasons and area closures. In 2003, most *RECREATIONAL FISHING* was restricted to relatively shallow waters (generally less than 20-27 fathoms).

To reduce fishing in rocky areas of the *CONTINENTAL SHELF*, trip limits for vessels using trawls configured with large footropes (those with footrope diameter greater than 8 inches) are typically set at minimal levels. This creates strong incentives for vessels using *BOTTOM TRAWL* gear to avoid prime *ROCKFISH* habitat areas, while not prohibiting the use of such trawls or closing specific areas. Two large areas off southern California are closed to most fishing activities as part of the plan to rebuild overfished cowcod, a species of rockfish . The closed areas (referred to as the Cowcod Conservation Areas or CCAs) encompass the primary habitat of cowcod and are intended to reduce possible encounters with this species.

Trip limits and area closures are currently based on incidental catch rates and fishing patterns through the use of a NMFS "*BYCATCH" MODEL*. The model estimates the total amounts of overfished species that would be caught coincidentally with available target species. The Council uses this information to set the amount and timing of trip limits for "target" species. The objective is to prevent catches of both target and overfished groundfish species from exceeding their allowable annual harvests. NMFS believes this new approach better accounts for the total mortality fishing of the overfished stocks than previous methods.

The "bycatch model" calculates the co-occurrence of each of five overfished species with healthy targeted stocks. To make these calculations, several trawl fishery target strategies are evaluated (for example, the *DTS COMPLEX*, arrowtooth flounder, etc.). Each target strategy has been evaluated in two-month periods to set a baseline of co-occurrence rates of overfished stocks throughout an entire calendar year. The analysis identified seasonal variations in co-occurrence rates which have been used to calibrated the model. Trip limits and seasons are intended to allow targeting on healthy stocks during times when incidental catches of overfished species are expected to be lowest (based on recent years). Management measures are adjusted as necessary during the season.

The No Action alternative includes "Rockfish Conservation Areas" (RCAs) where fishing is greatly restricted. By preventing fishing in times and areas where overfished species are most commonly encountered, the likelihood of catching them is greatly reduced. Outside the RCAs, more liberal fishing opportunities can be provided because few overfished stocks are present. This approach increases the complexity of the regulations and certain monitoring requirements but avoids the need for an expanded on-board observer program.

The "bycatch model" uses expected catch amounts for each major fishing sector, calculated before the season opens. Groundfish trip limits for commercial sectors are set based on previously observed ratios with various other species; these trip limits may vary by season if previously observed ratios show seasonal patterns. State fishery management and enforcement personnel monitor commercial *LANDINGS* throughout the year by tabulating state fish landings receipts (*FISH TICKETS*). Although landings of many species are monitored inseason, the landings data for overfished species may not be not used for inseason management. Due to the strong economic incentives to avoid reaching an overfished groundfish species OY or cap, coupled with the opportunity to discard fish prior to their being counted, managers assume fish tickets tend to underestimate the actual catches. There is currently no way to verify this inseason. However, onboard *OBSERVERS* ride selected vessels and collect information on amounts and rates of fish discarded at sea. Observer data are not tabulated during the season but are compiled in annual summaries after being matched with fish ticket and trawl *LOGBOOK* records. The new observed groundfish catch ratios are compared to the previous rates that were used to set the current trip limits. If the trip limit ratios differ substantially from the new observations, subsequent trip limits would be adjusted and other management measures may also require adjustments.

Alternative 2 would reduce groundfish bycatch by increasing the size of trip limits. This would be achieved by reducing the trawl fleet by 50% from 2002-2003 levels; the goal of maintaining a year-round fishery would continue. The focus on fleet reduction is based on the Council's Strategic Plan for Groundfish. This alternative includes the area/depth management and modeling approach of Alternative 1.

2.2.2 Alternative 2 (Larger Trip Limits and Trawl Fleet Reduction)

Alternative 2 would reduce groundfish *REGULATORY DISCARD* by increasing groundfish trip limit sizes and reducing the number of commercial fishing vessels, while maintaining as long a fishing season as practicable. Regulatory bycatch of groundfish (that is, groundfish that vessels must discard to avoid penalty), and particularly the rate of discard, increases as trip limits become smaller.

This alternative differs from the status quo in that the number of commercial groundfish trawl vessels would be reduced by 50% from the number that were permitted to land groundfish during 2002-2003. Trip limits would be larger because the total allowable catch would be shared among fewer participants.

The preferred method of fleet reduction is an industry-sponsored buy-back program. The buy-back program failed to achieve the full 50% reduction in the number of trawl permits. Under Alternative 2, the number of trawl permits would be reduced to the 50% level by other means. The Council has limited alternatives to achieve the additional reduction: eliminate permits by establishing eligibility criteria (for example, a minimum amount of groundfish landed in previous years, a minimum number of years of participation in the fishery, etc), require vessels to hold more than one trawl permit, or allow trawl permits to be converted to fixed-gear permits.

In establishing the current vessel license limitation program, the Council established minimum landing requirements for eligibility. Vessels that met the minimum requirements received licenses (permits). Only the most recent entrants and vessels with the smallest catch histories did not receive permits. It is likely that in reducing the number of eligible vessels, criteria based on amounts of groundfish landed would tend to eliminate those trawl vessels that have caught the fewest groundfish in recent years or participated less than other vessels. This reduction method could result in reducing effective fishing power of the trawl fleet by less than 50%.

Approval of the trawl buy-back program in 2003 will have a substantial effect: the status quo (no action alternative) has become very similar to Alternative 2.

2.2.3 Alternative 3 (Larger Trip Limits - Shorter Fishing Season)

Alternative 3 would reduce groundfish bycatch by increasing the size of trip limits. This would be achieved by eliminating the goal of maintaining a year-round fishery and establishing a short season or series of seasons. This alternative reflects one of the conclusions in the Council's Strategic Plan for Groundfish that, if fleet size is not reduced, "(m)aintaining a year-round fishery may not be a short-term priority." This alternative includes the area/depth management and modeling approach of Alternative 1.

Alternative 3 would reduce groundfish regulatory discard by increasing groundfish trip limit size and reducing fishing time (shortening seasons), without further reducing the number of trawl vessels. As with Alternative 2, this is based on the understanding that regulatory bycatch of groundfish, and particularly the rate of discard, increases as trip limits become smaller.

In contrast to Alternatives 2, the number of commercial fishery participants would not be reduced by 50% under Alternative 3. Instead, the commercial fishing season would be shortened as the method to create larger trip limits.

Methods of reducing fishing time are not specified in this alternative but are critical to the effects. For example, if the current 2-month periods are reduced to 1 month, larger vessels would not be affected much, and trip limits might not be much larger than current, because actual fishing time per vessel for each 2-month period is already less than one month. Vessels could be restricted to fishing only 3 of the 6 2-month periods.

A different way of reducing commercial fishery fishing time to six months would be to allow limited entry sector fishing for six months and open access fishing for six months while the limited entry sector is closed. For example, the limited entry fishery (except the whiting fishery) could operate during two 3-month periods, one in the spring (some period between February and June) and one in the fall (perhaps September, October and November). These open seasons fall mainly outside the shrimp and crab seasons. Open access fisheries might fill in between, i.e., summer and winter.

2.2.4 Alternative 4 (Vessel and Sector Catch Caps)

Alternative 4 would reduce bycatch by using a combination of vessel trip limits and catch (mortality) limits and establishing catch limits for various fishery sectors. A reserved portion of the overall allowable harvest would be made available to those individuals observed to have the lowest bycatch rates. This alternative includes the area/depth management and modeling approach of Alternative 1.

Alternative 4 would reduce bycatch by expanding the definition of "trip limit" to include catch or mortality limits for overfished species. These *CATCH LIMITS* would not be transferable between vessels and would expire at the end of each period. Catch limits or caps for overfished groundfish species would also be established for each fishing sector. A vessel reaching a catch limit would be required to stop fishing for all groundfish species; all vessels in a sector would be required to stop fishing when a catch limit for that sector is reached. An inseason catch monitoring or verification program would ensure sector catch limits are not exceeded. Larger retention limits for non-overfished groundfish would be made available to vessels carrying an approved monitoring system (observer or other method).

Nine fishery sectors are identified under the current regulations: *LIMITED ENTRY TRAWL*; limited entry *LONGLINE*; limited entry *POT*; three whiting sectors (*CATCHER/PROCESSOR*, *MOTHERSHIP* and *SHORE-BASED*); *OPEN ACCESS*; *TRIBAL*; and perhaps recreational. Additional sectors could be established by subdividing any of these sectors. Each sector would be monitored separately with stratified, partial observer coverage. Catch rates and closure dates for each sector would be projected based on observer reports.

This alternative would modify the definition of trip limits to include catch (mortality) limits and would also establish catch (mortality) caps for each sector. Vessels would no longer be required to discard overfished groundfish species, although they could choose to discard them. Non-overfished groundfish would be managed the same as under the status quo (no action) alternative, except that vessels carrying an observer (or other approved monitoring system, if any) would be eligible for larger trip (retention) limits for non-overfished species. However, they would still be required to stop fishing upon reaching a catch limit. The NMFS Observer Program would monitor each sector by placing observers on a portion of the vessels in each sector. Catch rates of overfished/restricted species would be projected to all unobserved vessels operating in the sector. Vessels not carrying a NMFS-funded observer could carry an observer at their own expense in order to be eligible for the larger trip limits. An electronic monitoring (video) option may be available if NMFS determines such a program would provide the necessary catch/mortality information. This could require increased retention of certain species.

Economic (that is, non-regulatory) bycatch/discard could also be addressed under this alternative by prohibiting discard or limiting the amount of groundfish that may be discarded. If allowed, discard would be measured by onboard observers (or electronic monitoring). If discard were prohibited, economic (non-regulatory) bycatch of groundfish would be greatly reduced.

The option of creating more sectors could reduce the need for other controls to limit fishing activities. To accomplish this, vessels would be assigned to one or more sectors, perhaps through an endorsement attached to the limited entry permit. When a sector limit is reached, further fishing by those vessels would be prohibited or severely curtailed. Bycatch (discard) under such an approach could be controlled by requiring *FULL RETENTION* or placing limits on discards. The primary differences between Alternative 4 and the previous three alternatives are (1) Alternative 4 would set vessel groundfish mortality caps for overfished groundfish species in addition to retention limits for other groundfish; (2) each vessel would be required to stop fishing when it reached any catch limit during a period; (3) every vessel would be assigned to one (or more) sectors; (4) each sector would have a set of annual catch caps for overfished (or other restricted) groundfish species; (4) vessels in a sector would have to stop fishing when any cap for the sector is reached, while vessels in other sectors would continue fishing. Catches by each sector would be monitored inseason, with actual catch statistics available quickly (either inseason or before the next season) so that adjustments could be made. Total catch OYs and discard caps would be set for overfished *STOCKS*, and sub caps would be set for each sector. Initial trip (retention) limits for vessels without observers would be calculated based on previously observed joint catch ratios of various groundfish species (the same as under status quo). Trip limits for observed vessels would be larger, based more on the OYs for those species. Onboard observers would monitor a subset of vessels in each sector, recording and compiling catch and discard of overfished groundfish species (and other specified species) inseason. This catch data would be expanded to the entire sector. Each sector would be managed to its groundfish caps based on this expanded "real time" information rather than based on ratios from previous years. This process would occur weekly, biweekly, or at some other appropriate frequency.

Under Alternative 4, a *RESERVE* would be set aside as a buffer to ensure any species OY or allocation is not exceeded; this reserve would be made available for vessels and/or sectors observed to have low incidental catch and/or bycatch rates. This would provide incentive for individual vessels to fish more selectively and to carry an observer if one is not provided by NMFS. In order to ensure their access to the reserve, vessels may need to carry an observer (or observers) at the vessel's expense so the vessel's catch and bycatch could be monitored accurately.

2.2.5 Alternative 5 (Individual Fishing (Catch) Quotas and Increased Retention)

Alternative 5 would reduce bycatch by establishing annual groundfish catch quotas for individual commercial fishers and other qualified entities. Monitoring would be focused at the individual vessel level rather than at the sector level.

Alternative 5 would reduce bycatch by assigning annual *CATCH LIMITS* or *INDIVIDUAL QUOTAS* to each limited entry commercial fisher, vessel, or other qualified entity. These catch limits would primarily apply to overfished groundfish stocks, but quotas would also be established for other groundfish stocks. Certain gear restrictions and other regulations would be relaxed to allow fishers/vessels to develop their own best practices to catch healthy groundfish stocks while avoiding the catch of overfished groundfish stocks.

Under Alternative 5, it may or may not be useful to distinguish between IQs for overfished groundfish stocks and IQs for other groundfish. In the event that such distinction is appropriate, catch allowances for overfished stocks might be referred to as "*RESTRICTED SPECIES CATCH QUOTAS*" or RSQs. In the long term, catch limits for other marine life could also be established (which might be referred to as prohibited species catch (PSC) limits), which could not be retained unless specifically authorized or required.

For clarity, this EIS considers two categories of individual quotas; both types would be transferable. Quotas of overfished or other restricted groundfish are called RSQs (restricted species quotas). Quotas for all other groundfish species are simply called IQs. There is no other distinction between them.

An IQ would be considered an authorization to catch a specified share or amount of the OY for a specified groundfish stock. A portion of some or all overfished stock OYs would be reserved for vessels with the best bycatch performance. (The Council would define "best performance" or *PERFORMANCE STANDARDS* at a later date. It could, for example, be based on low catch or catch rates of overfished species, low bycatch of non-groundfish species, or other factors.) A robust monitoring or catch verification program would be established to ensure catch caps are not exceeded.

To increase the effectiveness of IQs as a bycatch management program, certain regulations would be relaxed to allow fishers to modify their fishing operations and/or gear to better utilize their quotas. For example, gear endorsements could be modified to allow trawl vessels to use nontrawl gear, or to covert their trawl endorsement to a new category of longline, pot or generic gear endorsement. Quota holders would be allowed to buy and sell incidental catch allowances (RSQs) and individual transferable fishing quotas (IQs/IFQs) for other (non-overfished) groundfish.

There are several potential methods and criteria for initial allocation of quota shares, as well as ownership requirements, transfer methods, etc. There are also different definitions of "individual" possible. For example, "individual" could refer to or include vessel, vessel owner, fisherman, person, firm, cooperative, community or other entity. These issues would have to be debated in developing an effective IQ/bycatch management program. These issues are not analyzed in this EIS.

Alternative 5 would use direct incidental catch and bycatch controls at the level of the individual vessel. To reduce economic (non-regulatory) bycatch, discard of groundfish could be prohibited or restricted; if discarding were allowed, it would be measured as accurately as possible. All groundfish catch, whether retained or discarded, would be charged against the appropriate RSQ/IQ. Fewer controls would be needed to limit fishing activities, except that when a vessel reaches any catch limit it would have to stop all fishing until it acquired additional IQ or RSQ. Also, if a groundfish OY were reached, further fishing would be prohibited or severely curtailed. Bycatch (discard) under this approach could be controlled by requiring *INCREASED RETENTION* or placing limits on discards.

Alternative 5 is similar to Alternative 4 except that each commercial limited entry permit would be assigned annual individual caps (RSQs) for overfished groundfish stocks and IQs/IFQs for other groundfish species, and these would be transferable.

Initially, RSQs would be set for all limited entry commercial vessels. Catch limits for other species would be calculated based on previously observed joint catch ratios of various groundfish species. Onboard observers would monitor catch and discard of overfished groundfish species (and other specified species) inseason. Each vessel would be managed to its caps based on its own performance, using "real time" catch information rather than relying on ratios from previous years.

A reserve of various groundfish species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Also, any unused OYs of non-overfished groundfish would be made available to those vessels that had not taken their overfished species allowances.

Alternative 5 would require that every commercial groundfish vessel be closely monitored so all catch of overfished species would be observed and recorded. This close scrutiny would likely mean placement of fishery observers on every vessel. Alternative monitoring processes could be allowed if they resulted in the same level of data accuracy and completeness. For example, some vessels might be able to meet the standard by retaining all groundfish in conjunction with a video system to verify that no discard occurred.

2.2.6 Alternative 6 (No-take Reserves, Individual Catch Quotas, and Full Retention)

Alternative 6 would reduce bycatch to near zero by (1) closing large areas where overfished groundfish are most likely to be encountered and other areas of high bycatch of non-groundfish species, (2) establishing individual vessel catch allowances (caps) for overfished groundfish species, and (3) requiring each commercial vessel to carry an onboard observer at all times the vessel fishes. This alternative would include expanded area/depth closures (MPAs or marine reserves), bycatch limits and discard prohibitions. Certain gear regulations would be relaxed to allow vessels to improve bycatch reduction methods. As in Alternative 5, vessels could continue fishing until any cap was reached, and vessels with low incidental or bycatch rates would be provided additional fishing opportunities.

Alternative 6 would reduce bycatch of all species to very low levels by establishing long term closed areas where overfished groundfish and other sensitive species are most likely to be encountered, establishing incidental catch limits for individual vessels, prohibiting or severely restricting discard of groundfish species (and perhaps other species), and accurately accounting for all catch. The alternative would emphasize the identification and use of alternative fishing gears and methods that avoid capture of restricted species.

This alternative would use both indirect controls (no-take marine reserves) and direct bycatch controls of each individual vessel. The areas encompassing most of the distribution of all overfished groundfish stocks would be established as long-term marine protected areas to reduce the possibility those fish could be caught.

Alternative 6 is similar to Alternative 5 except the focus would be on reducing bycatch of overfished groundfish and other identified species to near zero by closing areas where encounters of those species are most likely. These areas would be designated as long term closed areas that could be reopened only through a deliberative process based on the best scientific information available. In addition, individual commercial groundfish vessels would be assigned a catch allowance of overfished groundfish species. These would be mortality limits or caps. Certain regulations would be relaxed to allow fishers to modify their fishing operations and/or gear to keep from exceeding their individual vessel caps.

A portion of the total allowable groundfish catch could be held in reserve for access by vessels with the lowest catch (or catch rates) of overfished species or bycatch rates of non-groundfish species. Initial groundfish catch limits for other species would be calculated based on previously observed joint catch ratios of various groundfish species. Discarding of groundfish would be prohibited or greatly restricted. Discarding of other species could be prohibited or restricted also. Onboard observers would monitor all vessels' catches of all species.

2.3 Summary of Environmental Impacts

This section summarizes the results and conclusions of the analysis in Chapter 4 of this document. Bycatch has two components: (1) the encounter/bycatch of unwanted and unintended fish and other marine life (that is, the capture component), and (2) the discard/bycatch component. (Each of these components has several sub-components.) The analysis shows that certain bycatch mitigation tools are relatively effective at reducing the encounter or capture, while other tools control what happens to the fish when caught. The analysis accepts a well-founded conclusion that fishing activities result in fish being caught, and that it is virtually impossible for a fisher to catch only the desired fish that are of the desired size and exactly the desired amount. In short, "bycatch" is an inevitable result of fishing, with rare exceptions.

A few basic relationship relationships describe the connection between fishing and catch. In general, the amount of fish captured is proportional to the amount of fishing effort, the efficiency (or selectivity) of the gear, and the numbers of fish present where the fishing occurs. With respect to the encounter of fish that a fisher does not want or would like to avoid, the unwanted catch of any species is also proportional to the combination of effort, gear selectivity, and the species abundance where the fishing takes place.

Measures that control the three general categories (the amount of effort, selectivity, and abundance or numbers of fish) can indirectly affect the amount of unwanted/unintended catch. The effects are indirect (or imprecise)[1/] because the relationships between effort, selectivity, fish abundance and catch are not mathematically constant. That is, reducing effort by two units will not necessarily be twice as effective as reducing effort by one unit, nor will four units be twice as effective as two. Likewise, gear selectivity cannot be measured or controlled precisely, nor can the effects of most changes be predicted with certainty. Abundance cannot be directly controlled, but closing areas of fish abundance can achieve a similar result. But mitigation measures based on effort, selectivity or abundance can by themselves achieve conservation objectives imprecisely at best because they really only control fishing efficiency. This is because such measures are contrary to another fundamental relationship: fishers want to improve their efficiency, either by increasing their catch or reducing their costs.

The other basic approach is to control the amount of catch directly through specified limits. The groundfish bycatch management program used this approach in controlling foreign nations' catches of designated bycatch species such as Pacific ocean perch and sablefish. If a nation's vessels were observed to reach a bycatch limit, that nation's fishing activities were terminated for the remainder of the year. That program relied on comprehensive monitoring by NMFS observers. When U.S. vessels displaced the foreign (whiting) fishery in the late 1980s, those vessels voluntarily carried NMFS-certified observers. High quality catch and bycatch data for the whiting fishery is available; salmon have been the primary species of bycatch

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1/ Only in their extremes can these factors precisely control the amount of catch, which occurs when they push catch to zero. For example, zero effort, using gear that never catches anything, or fishing only where no fish exist result in zero catch.

concern in this fishery, especially various chinook salmon runs that have been classified under the ESA. For the more traditional American commercial fishing vessels, catch limits took the form of groundfish retention limits, initially applied to individual fishing trips.

Trip limits may be considered a proxy for catch limits but they do not require vessels to stop fishing. Rather, they only require that a vessel not retain any more of the particular groundfish species. This approach was fairly effective in controlling the amounts of groundfish landed but is less effective in controlling the amounts of groundfish that are captured and killed. In recent years NMFS, the Council and public have become more aware of how poorly landed catch data reflect actual catches. It is clear there are substantial data gaps regarding the relationships between retained amounts and catch amounts. The NMFS observer program is addressing this issue, and these data gaps are shrinking as the observer program collects information on discards from the commercial groundfish fishing fleet. There are also data gaps regarding the relationships between recreational bag limits (which, like trip limits, are retention limits), catch estimates, and the amounts actually captured.

One program approach (the status quo/no action alternative) to resolving several bycatch issues is to estimate the amount of catch and close a fishery when an OY or allocation is reached. This approach includes specifying acceptable harvest methods, times, places, etc. Another program approach to controlling unwanted/unintended catch would be to assign each fisher a limit (or set of limits) and require each fisher to stop fishing upon reaching any limit. More emphasis would be placed on individual performance and accountability, with less emphasis on specifying when, where and how fish may be caught. In addition are numerous variations and combinations, such as assigning limits to groups of fishers or vessels, relying more heavily on area closures and further restricting fishing gears. Finally, it is important to realize that groundfish trip limits and bag limits have no force in controlling the amounts of non-groundfish species captured. Even prohibited species designations, unless combined with compliance requirements, only prohibit retention. Without compliance, no mitigation tools are effective. When fishers' incentives conflict with the objectives of the management tools, compliance is likely to be dependent on penalties and enforcement. When fishers' incentives are complementary to management objectives, self-policing increases.

The other aspect of bycatch is what happens to unwanted/ unintended fish; that is, are captured fish retained or discarded. The Magnuson-Stevens Act defines bycatch as fish that are not retained for sale or personal use; this aspect of bycatch could be eliminated by requiring fishers to retain every fish, regardless of its value, edibility or usefulness. In the short term, however, a primary result would be moving the location of discards from the ocean to the land. In the longer term, alternative uses of some or all fish might be found.

The analysis in Chapter 4 evaluates the effectiveness of each potential bycatch mitigation tool and assigns a rank to each. It also considers "side effects" of each tool, or how it may affect the catch of other species as well as how precisely it may achieve the desired result. The six alternatives under consideration are actually combinations of mitigation measures and monitoring requirements. The analysis evaluates those combinations and describes the overall effects, effectiveness and costs in general terms. Part of the process of selecting a preferred alternative will be evaluating the practicability of each alternative.

The following series of tables summarizes the results of the analysis, beginning with Table 2.3.1 that identifies the bycatch mitigation and monitoring tools included in each alternative. Table 2.3.2 summarizes how well each alternative achieves the stated purpose for the action, that is, how well they achieve the goals and objectives the Council has initially set for the bycatch management program.

Impacts on the biological environment are summarized in Table 2.3.3. Tables 2.3.4(a) and 2.3.4(b) summarize the social and economic impacts. The significance of those economic impacts is described in Table 2.3.5. These tables are also provided in Chapter 4 where the results are discussed in greater detail.

Table 2.3.1. Bycatch reduction methods (bycatch mitigation tools) included in the alternatives.

Goals and Objectives	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**	**Alternative 5**	**Alternative 6**
	Control bycatch by trip (retention) limits that vary by gear, depth, area; long season	Reduce bycatch by decreasing effort and permitting larger or more flexible trip limits (reduce	Reduce bycatch by reducing effort and permitting larger or more flexible trip limits (reduce commercial	Reduce all groundfish bycatch by re-defining trip limits to include catch limits, and establishing	Reduce all groundfish bycatch by establishing individual catch limits (individual quotas) for	Reduce all bycatch by large area closures and gear restrictions, individual bycatch caps, and increased
FISHERY MANAGEMENT TOOLS						
Harvest Levels						
ABC/OY	Y	Y	Y	Y	Y	Y
Set **overfished groundfish catch caps**	N	N	N	Y	N	Y
Use **trip limits**	Y	Y	Y	Y	N	N
Use **catch limits**	N	N	N	Y	Y	Y
Set individual vessel/permit catch	N	N	N	Y	Y	Y
Set groundfish **discard caps**	N	N	N	N	Y	Y
Establish **IQs**	N	N	N	N	Y	Y
Establish bycatch **performance standards**	N	N	N	N	Y	Y
Establish a reserve	N	N	N	Y	N/Y	Y
Gear Restrictions						
Rely on **gear restrictions**	Y	Y	Y	Y	N	Y
Time/Area Restrictions	Y	Y	Y	Y	Y	Y
Establish **long term closures for all groundfish fishing**	N	N	N	N	N/Y	Y
Establish **long term closures for on-bottom fishing**	N	N	N	N	N/Y	Y
Capacity reduction (mandatory)	Y	Y(50%)	Y	Y	Y	Y
Monitoring/Reporting						
Trawl logbooks	Y	Y	100%	Y		
Fixed-gear logbooks	N	N	100%	Y		
CPFV logbooks	N	N	N	Y		
Commercial **port sampling**	Y	Y	Y	>Y	N/Y	Y
Recreational	Y	Y	Y	>Y	Y	>>x
Observer coverage (commercial)	10%	10%	10%+logbook verification	increased, by sector	100%	100%
CPFV observers	N	N	N	Y	Y	100%
VMS	Y	Y	Y	Y	Y	Y
Post-season observer data OK	Y	Y	Y	N	N	N
Inseason observer data required	N	N	N	Y	Y	Y
Rely on fish tickets as the primary monitoring device for groundfish landings	Y	Y	Y	N	N	N

Table 2.3.2. Summary of how well alternatives achieve the stated purposes for the proposed action.

Purpose of Proposed Action	Alt 1 (no action)	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
Account for total fishing mortality by species	The current observer program provides statistically reliable estimations of groundfish mortalities.	I+	I+	S+	S+	S+
Establish monitoring and accounting mechanisms to keep total catch of each groundfish stock from exceeding the specified limits	Trip and bag limits, application of the “bycatch model” and inseason tracking of landings are moderately effective but less than 100% successful.	I+	I+	S+	S+	S+
Reduce unwanted incidental catch and bycatch of groundfish and other species	Area closures (Rockfish Conservation Areas), seasons and gear restrictions reduce unwanted catch. Trip limits create regulatory bycatch (discard).	I	I	S+	S+	S+
Reduce the mortality of animals taken as bycatch	Prohibited species must be returned to the sea as quickly as possible with minimum of injury.	U	U	U	U	S-
Provide incentives for fishers to reduce bycatch and flexibility/opportunity to develop bycatch reduction methods	Trip limits reduce the “race for fish” and provide some minimal opportunity and incentives to avoid bycatch.	I+	I-	CS+	S+	CS+
Monitor incidental catch and bycatch in a manner that is accurate, timely, and not excessively costly	The current program minimizes user and agency costs of monitoring catch and bycatch at the expense of precision and timeliness.	I	I	S+/S-	S+/S-	S+/S-
Reduce unobserved fishing-caused mortalities of all fish	Area closures (RCAs), gear definitions and seasons mitigate potential mortalities.	I	I	CS+	S+	S+
Gather information on unassessed and/or non-commercial species to aid in development of ecosystem management approaches.	Over a period of years, information on non-commercial and unassessed stocks will improve.	I	I	CS+	S+	S+

Performance Ratings, compared to status quo/no action alternative:

Substantial Beneficial (S+): Substantial improvement from status quo expected.
Substantially Adverse (S-): Substantially increased costs or reduced effectiveness expected.
Conditionally Substantial Beneficial (CS+): Substantial improvement expected if certain conditions are met or events occur, or the probability of improvement is unknown.
Conditionally Substantial Adverse (CS-): Substantially increased costs expected if certain conditions met, or the probability of occurrence is unknown.
Insubstantial Beneficial (I+)/Insubstantial Adverse (I-): Changes are anticipated but not expected to be major.
Unknown (U): This determination is characterized by the absence of information sufficient to adequately assess the direction or magnitude of the impacts.

Table 2.3.3. Significance of effects on the biological environment.

Resource	Alt 1 (no action)	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
Groundfish	The current bycatch program provides statistically reliable estimations of groundfish bycatch and bycatch mortalities and mitigates many potential impacts. Trip and bag limits, application of the "bycatch model" and inseason tracking of landings are moderately effective but less than 100% successful in preventing overfishing. Trip limits create regulatory bycatch of groundfish.	I+	I+	S+	S+	S+
Other Relevant Fish, Shellfish and Squid	Impacts on species such as Pacific halibut are reduced from recent years due to large area closures to protect overfished groundfish (primarily rockfish).	U	U	S+	S+	S+
Protected Species	Area closures (Rockfish Conservation Areas), seasons and gear restrictions reduce potential catches. Protected species must be returned to the sea as quickly as possible with minimum of injury.	I+	I-	CS+	CS+	CS+
Salmon	Salmon bycatch in the Pacific whiting fisheries is closely monitored. Voluntary bycatch avoidance methods have proven effective, especially in the at-sea sectors	U	U	I+	I+	CS+
Seabirds	Few seabird interactions have been documented; seasons and area closures could increase or decrease interactions.	I+	I-	CS+	CS+	CS+
Marine Mammals	Few marine mammal takings have been documented, and all are within current standards.	I+	I-	S+/ S-	CS+	CS+
Sea Turtles	No sea turtle interactions have been observed in the groundfish fisheries.					
Miscellaneous Species	Area closures (RCAs), gear definitions and seasons mitigate potential mortalities. Little information is available.	U	U	CS+	CS+	S+
Biological Associations	Over a period of years, information on non-commercial and unassessed stocks will improve. Little information is available at this time.	U	U	CS+	S+	S+

Significance Ratings, compared to status quo/no action alternative:

Significant Beneficial (S+): Significant improvement from status quo expected.
Significant Adverse (S-): Significantly increased adverse impacts or reduced effectiveness expected.
Conditionally Significant Beneficial (CS+): Significant beneficial impacts expected if certain conditions are met or events occur (such as full observer coverage), or the probability of impacts is unknown.
Conditionally Significant Adverse (CS-): Significantly increased adverse impacts expected if certain conditions met, or the probability of occurrence is unknown.
Insignificant Beneficial (I+)/Insignificant Adverse (I-): Minor impacts, if any, are anticipated.
Unknown (U): This determination is characterized by the absence of information sufficient to adequately assess the significance of the impacts.

Table 2.3.4(a). Summary of effects of Alternatives 1, 2 and 3 on the social and economic environment. (Alternatives 4, 5 and 6 are addressed in the following table.)

	Alternative 1	Alternative 2	Alternative 3
Incentives to Reduce Bycatch	Quota-induced discards can occur when fishers continue to harvest other species when the harvest guideline of a single species is reached and further landings of that species are prohibited. As trip limits become more restrictive and as more species come under trip-limit management, discards are expected to increase. In addition, discretionary discards of unmarketable species or sizes are thought to occur widely. However, in comparison to a "race for fish" allocation system, the current management regime provides harvesters a considerable amount of flexibility to reduce unwanted catch and discards.	Reducing the level of effort in the groundfish fisheries and increasing trip limits would likely reduce the level of groundfish bycatch (discard).	If trip limits increase, the level of groundfish bycatch (discard) would be expected to decline.
Commercial Harvesters	By spreading out fishing more evenly over the year, the current management regime helps maintain traditional fishing patterns. However, landings of major target species (other than Pacific whiting) are expected to continue to decline as OYs are reduced to protect overfished species. Declining harvests lead to significant decreases in total groundfish ex-vessel value.	Further fleet reduction would be expected to reduce (but not eliminate) extra capacity in the fishery and to restore the fleet to some minimum level of profitability.	A combination of higher trip limits and a reduction in the length of the fishing season would be expected to lead to an overall reduction in variable fishing costs. With larger trip limits, revenues per trip are expected to increase. However, the overall impact of this alternative on costs and revenues would depend on when individual participants were allowed to fish. For example, fishers may be unable to fish for certain species at optimal times.
Recreational Fishery	Landings of major target species are not expected to increase and may decline further if OYs are reduced to protect overfished species. Decreased harvests lead to significant decreases in recreational value.	Changes in landings of major species targeted in the recreational fishery would be expected to be insignificant.	Effects as described in Alternative 2
Tribal Fishery	Changes in landings of major species targeted in tribal fisheries are expected to be insignificant.	Effects as described in Alternative 1	Effects as described in Alternative 1
Buyers and Processors	The current management regime reduces the likelihood that processing lines will be idle by fostering a regular flow of product to buyers and processors. However, decreased deliveries of groundfish to processors and buyers will result in significant decrease in groundfish product value.	No significant changes in the total amount of fish delivered to processors would be expected. Processors in ports that experience a reduction in fleet size may be negatively affected if they are unable to obtain supplies of fish from alternative sources	Larger trip limits would not be expected to affect the total amount of fish that harvesters deliver to processors. However, with vessels taking longer and potentially fewer trips, processors would have fewer boats to schedule for landings and unloading, reducing their average costs. On the other hand, costs could increase if processors were unable to control the flow of product throughout the year and capital is idle during closed periods.

Table 2.3.4(a). Summary of effects of Alternatives 1, 2 and 3 on the social and economic environment. (Alternatives 4, 5 and 6 are addressed in the following table.)

	Alternative 1	Alternative 2	Alternative 3
Communities	By maintaining year-round fishing and processing opportunities, the current management regime promotes year-round employment in communities. However, groundfish employment and labor income are expected to continue to decline, resulting in economic hardship for businesses involved in the groundfish fisheries. These businesses are expected continue to diversify to reduce dependence on groundfish fisheries.	The direction and magnitude of many of the economic effects on particular coastal communities are uncertain, as the distribution of the post-buyback fleet is uncertain. If further reduction in fleet capacity with higher trip limits were successful in increasing net revenues or profits to remaining commercial fishers, positive economic impacts on the communities where those fishers land their fish, home port and reside would be expected. On the other hand, some communities may experience a significant loss of vessels and a consequent decrease in income, jobs and taxes.	The impacts are uncertain, as community patterns of fishery participation vary seasonally based on species availability as well as the regulatory environment and oceanographic and weather conditions. If higher trip limits were successful in increasing net revenues or profits to fishers, positive economic impacts on the communities where those fishers land their fish, home port, and reside would be expected. On the other hand, seasonal closures could leave crew members at least temporarily unemployed.
Consumers	The current management regime allows buyers and processors to provide a continuous flow of fish to fresh fish markets, thereby benefitting consumers. Consumers of fresh or live groundfish may be adversely affected by reduced commercial landings. However, changes in benefits to most consumers of groundfish products would be expected to be insignificant due to availability of substitute products.	Effects as described in Alternative 1	Consumers of fresh or live groundfish could be unable to obtain fish from the same sources for half of the year unless the harvest sectors are split into two groups, with one group of vessels active at any given time.
Fishing Vessel Safety	Some gains in fishing vessel safety are at least partially realized under the current management regime, as fishers are able to fish at a more leisurely pace and avoid fishing in dangerous weather or locations. However, safety of human life at sea may decrease if reduced profits induce vessel owners to forgo maintenance, take higher risks or hire inexperienced crews.	Increases in net revenue to harvesters resulting from increases in trip limits may enhance their ability to take fewer risks and use their best judgment in times of uncertainty, thereby increasing vessel safety.	The effects on vessel safety may be mixed. Increases in net revenue to harvesters resulting from increases in trip limits may lead to reductions in injury and loss of life because of harvester's enhanced ability to take fewer risks and use their best judgment in times of uncertainty. However, set seasons make it more difficult for harvesters to make wise decisions as to when and where to fish.
Management and Enforcement Costs	The management regime is expected to continue to be contentious, difficult and expensive. Technological developments such as VMS may mitigate the rate at which management costs escalate.	Costs are expected to decrease, as fewer vessels are generally easier and less expensive to monitor.	Effects will vary depending on the way the seasonal closure is structured. Costs are expected to decline if there is no fishing activity to monitor for 6 months of the year. However, there will be increased costs if permit holders are divided into groups.

Table 2.3.4(b). Summary of effects of Alternatives 4, 5 and 6 on the social and economic environment. (Alternatives 1, 2 and 3 are addressed in the preceding table.)

	Alternative 4	Alternative 5	Alternative 6
Incentives to Reduce Bycatch	While it would be in the best interest of all vessels within a sector to reduce the catch of overfished species, a "race for fish" could develop in which individual vessels eschew fishing practices that reduce bycatch in order to attain their landing limits as quickly as possible. Setting individual catch limits would prevent that. In addition, if cooperative patterns of behavior emerge, decreases in bycatch would be expected.	The amount of fish discarded by each vessel would be counted against the vessel's limit. This measure provides strong economic incentives to reduce the catch of unwanted fish because it "internalizes" the costs of discarding fish.	MPAs would prohibit fishers from fishing in certain areas in order to reduce the probability that fish will be caught and discarded, while the 100% retention requirement would be the primary means of reducing groundfish bycatch (discard) outside of MPAs. Prohibiting discard would produce a strong incentive to avoid unwanted catch because the costs of sorting, storing, transporting and disposing of fish that cannot be sold may be substantial. If vessel groundfish quotas are transferable, Alternative 6 would be similar to Alternative 5; if not transferable, negative effects would be much more significant and more similar to Alternative 4.
Commercial Harvesters	A reduction in harvest and exvessel revenues could result from early attainment of overfished species sector caps. However, the total amount of fish available for retained harvest would be expected to increase, as vessels would increase retention of groundfish, and the level of bycatch would be measured more accurately through expanded observer coverage. The economic benefit of increased landings must be weighed against the additional operating costs that vessel owners would incur from the expanded observer coverage. The allocation of catch limits to individual sectors could lead to economic benefits if private agreements allocating transferable harvesting privileges were negotiated.	Current vessel owners as a group would likely benefit from a system that allocates freely transferable and leaseable quota shares to vessel owners on the basis of catch histories. Moreover, the total amount of fish available for harvest would increase, as bycatch would be measured more accurately through expanded observer coverage. Not all vessel owners would benefit equally, and the relative benefits would depend on the allocation formula. In addition, the economic benefits must be weighed against the additional operating costs that vessel owners would incur from the expanded observer coverage.	Some measures would significantly increase fishing costs, while other would reduce them. For example, 100% groundfish retention, full observer coverage, and establishment of MPAs would increase average costs, whereas the establishment of ITQs for groundfish species would reduce costs.
Recreational Fishery	This alternative may have a negative economic effect on recreational fishers if its sector catch limit were exceeded. The ability to detect excessive catches within the recreational sector would be enhanced by a CPFV observer program and expanded port/field sampling. The ability of the recreational sector to avoid a fishery closure by controlling catch of overfished species through an incentive program is likely to be limited, as there are many and diverse participants. Dividing the recreational sector into geographical (e.g., state-based) subsectors could mitigate some of the negative effects.	The creation of tradable quota shares for the commercial fishing/processing sectors is not expected to apply to the recreational fishery. The possibility of creating ITQs for recreational fishers may exist, but any discussion of how such a allocation would be achieved or its effects on recreational fishers would be speculative.	Rights-based system effects would be as described in Alternative 5. MPAs could benefit recreational fishers over the long term if local catch rates and fish size increased due to spillage of adults out of the MPAs. On the other hand, if MPAs resulted in geographic redistribution of the commercial and recreational fleets, the concentration of fishing effort in the areas that remain open could lead to localized stock depletion, reduced recreational catch per unit effort, and reduction in the quality of the fishing experience.
Tribal	Changes in landings of major species targeted in tribal fisheries are expected to be insignificant.	Effects as described in Alternative 1	Effects as described in Alternative 1

Table 2.3.4(b). Summary of effects of Alternatives 4, 5 and 6 on the social and economic environment. (Alternatives 1, 2 and 3 are addressed in the preceding table.)

	Alternative 4	Alternative 5	Alternative 6
Fishery			
Buyers and Processors	The economic effects on buyers and processing companies are uncertain because of the uncertainty as to how well vessel owners within sectors can successfully manage bycatch. To the extent that commercial harvesters adopt bycatch-reducing fishing tactics, processors and buyers would be expected to benefit from higher catches. On the other hand, if an entire fishing sector is shutdown, buyers and processors may experience significant shortages of fish.	Buyers and processors would be expected to benefit from the anticipated increases in fish landings. The overall level of benefits and the distribution of benefits across processors may depend largely on the formula for allocating quota shares. Arguments have been made that harvester-only ITQ programs may result in stranded capital in the processing sector and a shift in the balance of bargaining power toward harvesters. These potential adverse effects could be mitigated if processors were also allocated quota shares.	The net economic effect on buyers and processors is uncertain. In general, buyers and processors would be expected to benefit from the anticipated increases in fish landings that result from the implementation of a rights-based system. The 100% retention requirement could also result in a large increase in landings. However, it is uncertain how much of the additional fish retained would be marketable. Because of their lack of mobility, buyers and processors may be especially negatively affected by MPAs. However, the effects of MPAs on specific buyers and processing companies will depend in part on changes in local supply and how processors have adapted to current supply situations.
Communities	To the extent that harvesting sectors are not shut down, no significant economic impact on communities is likely. However, if sector closures occurred, there would likely be negative impacts in fishing communities, particularly if processing plants were also closed.	Consolidation of fishing and processing activities to fewer vessels and plants would likely result in reductions in the numbers of crew members and processing workers employed. Granting quota shares to community groups could help maintain existing harvesting and processing patterns and serve to meet concerns about employment in communities.	Effects of a right-based management system as described in Alternative 5. MPAs would be expected to help ensure harvests for future generations and the sustained participation of communities in groundfish fisheries. If, however, MPAs resulted in substantial decreases in groundfish catches over the short term, the economic hardships that fishing families and other members of communities are experiencing under Alternative 1 (no action) would be exacerbated.
Consumers	If no early closures of major harvesting sectors occur, the impact on consumers would be expected to be negligible. However, if major fishing sectors were shut down, consumers of fresh or live groundfish could be adversely affected.	Consumers would be expected to benefit from the anticipated increases in fish landings. There is some chance that consumers could be negatively affected, if a rights-based system leads to a decrease in the overall competitiveness of markets for certain groundfish products (e.g., live fish). The likelihood of this occurring would depend both on the level of consolidation that might occur and the elasticity of demand for particular products.	Consumers would benefit from the anticipated increased landings that result from a rights-based system. In addition, over the long term, MPAs that effectively increase the size and variety of seafood species could make consumers better off. On the other hand, large MPAs could substantially decrease seafood supply enough to make consumers worse off, at least in the short term. MPAs could have a positive effect on those consumers who derive non-consumptive benefits from marine ecosystems, including non-market benefits (e.g., existence value).
Fishing Vessel Safety	The effects on vessel safety are uncertain. Possible increases in the profitability of harvesting operations could lead to reductions in injury and loss of life because of harvesters' enhanced ability to maintain equipment, take fewer risks and use their best judgment in times of uncertainty. Without individual vessel catch limits, if an intense "race for fish" could develop. The increased competition among fishers would likely increase the risks they would be willing take to harvest fish.	Possible increases in the profitability of harvesting operations would likely lead to reductions in injury and loss of life because of harvesters' enhanced ability to maintain equipment, take fewer risks and use their best judgment in times of uncertainty.	The net effect of the various measures included in this alternative on fishing vessel safety is uncertain. The establishment of ITQs for groundfish species is expected to promote vessel safety by reducing the pressure to fish under dangerous conditions. On the other hand, the establishment of MPAs may result in a reduction in fishing vessel safety if the closure of fishing grounds results in vessels fishing farther from port and possibly in more hazardous areas.

Table 2.3.4(b). Summary of effects of Alternatives 4, 5 and 6 on the social and economic environment. (Alternatives 1, 2 and 3 are addressed in the preceding table.)

	Alternative 4	Alternative 5	Alternative 6
Management and Enforcement Costs	Costs would be expected to increase as catch limits were allocated over an increasing number of sectors. It would be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches within each sector. An expanded port/field sampling program to improve estimates of recreational catch would entail a larger budget for the state and federal agencies currently involved in data collection.	The costs of monitoring, enforcement and administration would be expected to increase significantly. Cost recovery measures such as a fee on quota holders would be expected.	Full (100%) observer coverage would be required, which would facilitate enforcement of a full retention regulation. The enforcement costs of establishing MPAs vary with several factors, including the location, number, size, and shape of the MPAs and types of activities restricted and allowed.

Table 2.3.5. Significance of effects on the social and economic environment.

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Incentives to Reduce Bycatch	CS+/CS-	CS+	CS+	S+	S+	S+
Commercial Harvesters	S+	S+	CS+	CS+/CS-	S+/S-	S+/S-
Recreational Fishery	S-	I	I	CS-	I	S+/S-
Tribal Fishery	I	I	I	CS-	I	CS-
Buyers and Processors	S+/S-	I/CS-	I/CS-	CS+/CS-	CS+	CS+/CS-
Communities	S+/S-	CS+/CS-	CS+/CS-	CS-	CS+	CS+/CS-
Consumers	S+/S-	I	CS-	CS-	CS+	CS+/CS-
Fishing Vessel Safety	S+/S-	S+	S+/S-	CS-	S+	S+/S-
Management and Enforcement Costs	S-	S+	CS+/CS-	S-	S-	S-

Significance Ratings:

Significantly Adverse (S-): Significant adverse impact based on ample information and the professional judgment of the analysts.

Conditionally Significant Beneficial (CS+)/Conditionally Significant Adverse (CS-): Conditionally significant is assigned when there is some information that significant impacts could occur, but the intensity of the impacts and the probability of occurrence are unknown.

Insignificant Impact (I): No significant change based on information and the professional judgment of the analysts..

Unknown (U): This determination is characterized by the absence of information sufficient to adequately assess the significance of the impacts.

3.0 The Affected Environment

Words printed in THIS TYPE are defined in the glossary at the end of this document. Other words are also defined.

3.1 Introduction

Groundfish *BYCATCH* and its characteristics (e.g., species, extent of harm, quantity, distribution in time and space) result from the dynamic and complex interaction of attributes of the species, the fisheries, and the affected *ENVIRONMENT*, both physical and biological. Life history strategies can influence vulnerability to bycatch at the level of an individual, a population, or group of species. For example, fish morphology (e.g., size, shape, presence of spines, large gill cover), distribution (e.g., preferred temperature, in deepwater, along cliffs) and behavior (e.g., schooling, inhabiting crevices, fast-swimming) affect how vulnerable a fish or species is to capture or harm by a particular gear. Fishers continuously adjust their gears, fishing practices and areas, to the extent allowed by regulation, to take advantage of these attributes in order to efficiently maximize the harvest of targeted species, as well as to reduce the harvest of unwanted species. The physical and biological environment also influences the distribution and abundance of species, largely through the availability and abundance of suitable habitat, prey, predators, competitors, and reproductive opportunities.

Chapter 3 describes various components of the coastal marine *ECOSYSTEM* and how people and communities use and rely on the groundfish resources of this region. The groundfish FMP and management regime covers groundfish stocks off Cape Flattery, Washington to the California border with Mexico. Hundreds of plant and animal species occur along the West Coast and groundfish-related bycatch may affect many of them. To make this chapter easier to read and understand, much of the detail on the biology of species and associated literature citations, have been placed in an appendix (See Appendix A).

This chapter describes the affected environment as it is today (2003), which is the baseline environmental condition. The baseline represents the status of environmental attributes at a time before the proposed action is implemented, and in Chapter 4 serves as a point of comparison to evaluate possible significant impacts. The status quo environmental condition is the result of millions of years of natural events and changes, and at least 150 years of human-caused events and changes. Humans have affected the downstream sediment transport, which has affected the amount and characteristics of sediment entering the marine environment. Tree harvesting, on the other hand, sometimes results in increased erosion and sediment transport, especially in watersheds with few or no dams. Oil and mineral exploration and extraction have undoubtedly affected the ocean physical environment, at least in the immediate vicinity of those activities. Fishing activities have also contributed to changes in the physical environment.

The biological environment has also been directly affected by fishing and other marine harvesting activities. For example, several recent studies have suggested that removal of whales and other marine mammals has created cascading effects throughout marine *FOOD WEBS*. More recently, fishing has contributed to reduced abundance of several groundfish species, resulting in NOAA Fisheries designating nine species as "overfished."

How The Chapter Is Organized

3.1.1 How The Chapter Is Organized

Chapter 3 describes the human environment as it exists today. To help set the context for the analysis of impacts, Section 3.2 provides a brief description of the physical environment, including marine geology, climate and currents. Section 3.3 describes the biological environment, including the biology of selected species: important groundfish species, protected species, and other relevant fish and shellfish species. Several species or species groups are given special emphasis in this chapter because of concerns regarding their population status and relevancy to bycatch issues. These include nine *OVERFISHED* groundfish species and protected marine species including Pacific salmon, marine birds, marine mammals and sea turtles. Other important species include those with substantive bycatch of groundfish in a non-groundfish fishery such as for pink shrimp; with substantive bycatch of the species in a groundfish fishery, such as Pacific halibut; especially vulnerable species such as Dungeness crab in softshell condition and long-lived and slowly reproducing species such as sharks and rays. Known *TROPHIC* relationships are identified, as are species that may be directly affected by groundfish fishing operations (for example, accidentally captured and/or killed by groundfish operations).

Section 3.4 describes the social and economic environment; that is, the human uses of West Coast groundfish stocks, and how these activities relate to other fishing activities in the region. Section 3.4.1 identifies incentives and disincentives relating to bycatch. Sections 3.4.2-3.4.8 describe the commercial, recreational and Tribal fisheries, commercial fish buyers and processors, and coastal communities where groundfish-related activities occur are described. Section 3.8 discusses vessel safety issues, and Section 3.9 describes management and enforcement activities and costs. Section 3.10 describes other fisheries that take groundfish incidentally (open access, non-groundfish fisheries) to provide a broader view of catch and bycatch on the West Coast.

3.2 The Physical Environment

3.2 The Physical Environment

Essential Fish Habitat (EFH) for groundfish is defined as the aquatic *HABITAT* necessary to allow for groundfish production to support long-term sustainable fisheries for groundfish and for groundfish contributions to a healthy ecosystem. This approach focuses on ecological relationships among groundfish species and between the species and their habitat. These habitat types are described primarily by physical features with the caveat that EFH also includes the associated biological communities. EFH for groundfish is identified by seven major habitat types: rocky *SHELF*, non-rocky shelf, continental slope/basin, canyon, *NERITIC* zone, oceanic zone and *ESTUARINE*. EFH descriptions have been incorporated in the FMP in both section 11.10 and in a detailed appendix (available online at http://www.nwr.noaa.gov/1sustfsh/efhappendix/page1.html. Groundfish EFH is currently being re-evaluated in a separate EIS.

Information to describe the physical environment is drawn primarily from the following sources: PFMC (in prep.), OCNMS and GFNMS websites and Fran Recht (PSMFC, personal communication).

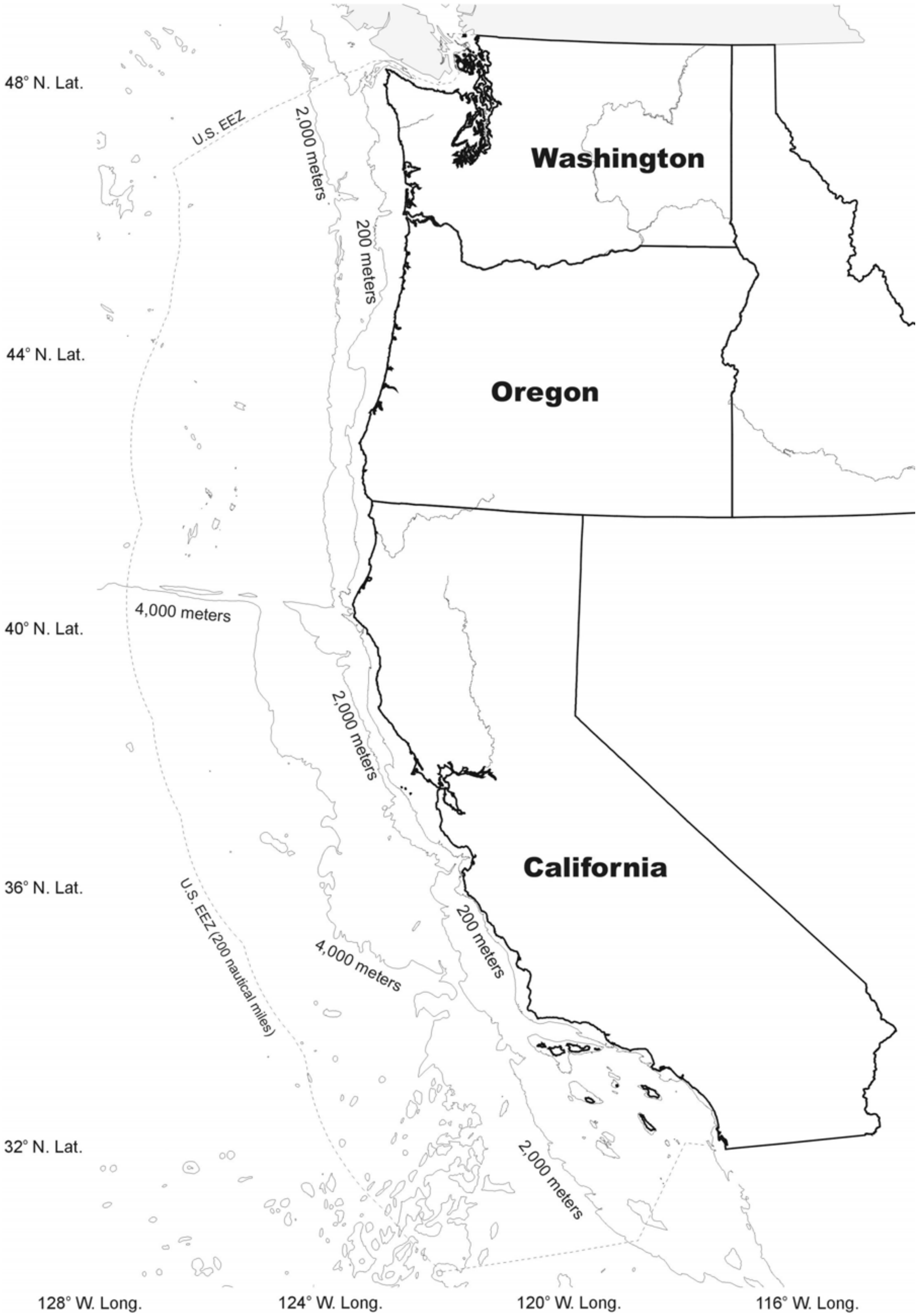
The geological structure and ocean environment affect the distribution of fish, which affects catch, incidental catch, and bycatch.

Geology **Bathymetry** and physical topography help determine habitat by influencing its physical structure and also the *CO-OCCURRENCE* of other species. Groundfish species are harvested in the *PELAGIC* zone, close to the bottom, or on the bottom, mostly within 50 miles of the shoreline where maturing and adult stages are found. Mud, sand, gravel, and exposed rocky areas, along with associated biological *COMMUNITIES*, make up the varied benthic habitats for groundfish on the continental margin.

The continental shelf off the West Coast is relatively narrow. It is generally widest from Oregon north and narrow off California.

The continental margin and waters out to 200 miles, the seaward boundary of the EEZ, are important habitat for groundfish and other marine species affected by groundfish fishing. The continental margin is composed of the

Figure 3.1. Bathymetry off the West Coast of the U.S.



CONTINENTAL SHELF and *CONTINENTAL SLOPE* - the steeper, deeper part of the continental margin. The U.S. West Coast is characterized by a relatively narrow continental shelf. The 100 fathom (200 m) depth contour shows a shelf break closest to the shoreline off Cape Mendocino, Point Sur, and in the Southern California Bight; and widest from central Oregon north to the Canadian border, as well as off Monterey Bay. Deep submarine canyons pocket the EEZ, with depths greater than 4,000 m south of Cape Mendocino. Major estuaries along the coast include San Francisco Bay, Columbia River, Willapa Bay, Grays Harbor, and the Strait of Juan de Fuca. A number of small estuaries occur all along the West Coast.

California Current System Biological characteristics of species, combined with physiographic features, are important determinants of changes in distribution. More mobile and schooling species, such as Pacific whiting, may vary in location *en masse* as they move in response to environmental conditions and prey availability. Current regimes may also control the distribution of larvae, helping to determine the location of adult populations. As mentioned earlier, fish distribution is an influential factor in determining bycatch, and thus, currents and changes to them can affect bycatch.

> The West Coast marine environment is part of the California Current ecosystem. The current is a major influence on the all marine plants and animals in the region.

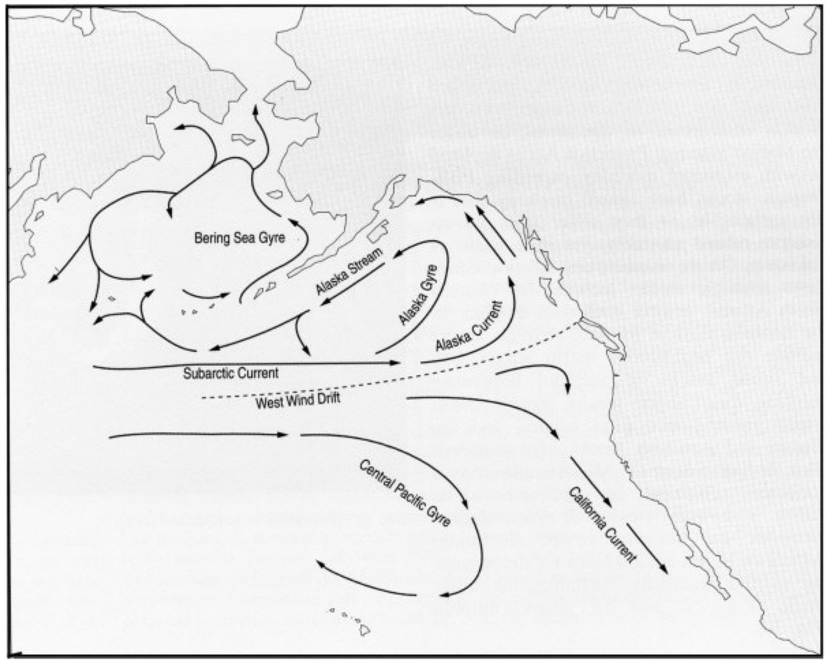
The West Coast marine environment is part of the California Current ecosystem (Figure 3.2). Large scale ocean currents, the North Pacific and Alaska gyres in particular, create a dynamic coastal environment. The North Pacific Current crosses the Pacific Ocean from Japan to Canada where it encounters the continental margin near Vancouver Island. The current splits into a northward flowing current carrying water into the Gulf of Alaska and a southward flowing current carrying water along the coast from Washington to California. This broad, shallow surface current which flows southward is called the California Current. It is strongest during the summer and is opposed by a weaker northward flowing and deeper California Undercurrent.

The California Current system changes significantly during the winter. The California Current moves farther offshore and the continental shelf is dominated by a strong northward flowing Davidson Current associated with winter storms.

> Coastal winds help create major nutrient upwelling as deep, nutrient-rich water rises against the coastline. This increases ocean production, especially in upwelling areas.

Influenced by the California Current system and coastal winds, waters off the U.S. West Coast are subject to major nutrient upwelling as deep, nutrient-rich water is upwelled against the coastline. During periods of strong upwelling, primary ocean

Figure 3.2. Major ocean currents off the West Coast of North America.



productivity is enhanced, increasing overall ocean production throughout many different trophic levels including those occupied by groundfish species.

Shoreline topographic features such as Cape Blanco and Point Conception, and bathymetric features such as banks, canyons, and other submerged features, often create large-scale current patterns such as eddies, jets, and squirts. For example, a current jet off Cape Blanco drives surface water offshore, which is replaced by upwelling sub-surface water. One of the better known current eddies off the West Coast occurs in the Southern California Bight between Point Conception and Baja, California, wherein the current circles back on itself by moving in a northward and counterclockwise motion just within the Bight.

Long and short term climate conditions affect the size and distribution of fish populations as well as other marine animals.

Climate Climate can influence the distribution and abundance of marine species, which in turn, can be reflected in bycatch type and amount. Population data on some groundfish species seem to show a linkage between climate and recruitment. The effect of *El Niño-Southern Oscillation* (*ENSO*) events on climate and ocean productivity in the northeast Pacific is relatively well-known. For example, Pacific whiting tends to have stronger year classes following an El Niño event than in other years. Also, some localized larval rockfish populations have shown lower survival rates in years when coastal upwelling and plankton production was reduced by El Niño events.

Periods of warmer or cooler ocean conditions and the event of shifting from warm to cool or vice versa can all have a wide array of effects on marine species abundance. Ocean circulation varies during these different climate events, affecting the degree to which nutrients from the ocean floor mix with surface waters. Periods of higher nutrient mixing tend to have higher phytoplankton (primary) productivity, which can have ripple effects throughout the *FOOD WEB*. In addition to changes in primary production, climate shifts may affect zooplankton (secondary) production in terms of increasing or decreasing abundance of the zooplankton biomass as a whole or of particular zooplankton species. Again, these changes in secondary production ripple in effect through the food web. Upper trophic level species depend on different lower order species for their diets, so a shift in abundance of one type of prey species will often result in a similar shift in an associated predator species. This shifting interdependency affects higher order species like groundfish in different ways at different life stages. Some climate conditions may be beneficial to the survival of larvae of a particular species but may have no effect on an adult of that same species.

Some species thrive in colder water, while others do better in warmer water. Both short term and long term climate events influence survival and reproduction.

EL NIÑO and *LA NIÑA* events are examples of short-scale climate change, six-month to two-year disruptions in oceanic and atmospheric conditions in the Pacific region. An El Niño is a climate event with trends such as a slowing in Pacific Ocean equatorial circulation, resulting in warmer sea surface conditions and decreased coastal upwelling. Conversely, a La Niña is a short-scale climate events characterized by cooler ocean temperatures. In years of poor upwelling or when El Niño warms the waters off the West Coast, ocean productivity is reduced. Under severe El Niño conditions, species distributions can change radically.

Recently, scientists have concluded that large scale regime shifts overlay shorter term El Niño and La Niña events, creating longer term changes in productivity associated with decades-long warm or cold periods. In the past decade a still longer period cycle, termed the *PACIFIC DECADAL OSCILLATION* or *PDO*, has been identified. Although similar in effect, instead of the 1 year to 2 year periodicity of ENSO, PDO events affect ocean conditions for 15 years to 25 years. The PDO shifts between warm and cool phases. The warm phase is characterized by warmer temperatures in the northeast Pacific (including the West Coast) and cooler-than-average sea surface temperatures and lower-than-average sea level air pressure in the central North Pacific; opposite conditions prevail during cool phases. Because the effects are similar, "in-phase" ENSO events (that is, an El Niño during a PDO warm phase) can be intensified.

3.3 The Biological Environment

3.3 The Biological Environment

Detailed descriptions of the life history and status of groundfish, other fish and shellfish, marine mammals, sea turtles and seabirds are provided in Appendix A. For ease of readability, these descriptions are summarized below and the associated information sources are only cited in the appendix. Information to describe productivity and vegetation is drawn primarily from the following sources: PFMC (in prep.), OCNMS and GFNMS websites and Fran Recht (PSMFC, personal communication).

Primary and Secondary Productivity

Primary production (phytoplankton abundance) and secondary production (zooplankton abundance) influence the abundance of higher trophic level organisms, including fish populations targeted by fishers. Changes in production in terms of increasing or decreasing abundance of the zooplankton biomass as a whole or of particular *ZOOPLANKTON* species ripple through the food web.

Upwelling zones are generally considered the most productive in the ocean. Upwelling occurs in the spring and early summer off central California. Submarine canyons along the Washington coast are sites of increased upwelling.

Vegetation

Brown, red, and green algaes and coralline algaes are abundant in the intertidal areas of rocky shorelines. These algae provide rich food supplies and provide cover for diverse communities of animal species. Eel grasses are also important spawning and nursery areas in estuaries.

The vegetation zone extends to from shore to depths where light penetration becomes insufficient for substantial plant growth.

Kelp forests provide cover for many groundfish species, especially rockfishes, and they attract other species that may be prey, predators, or competitors with groundfish. Kelp forests of the Washington, Oregon and northern California coasts are dominated by bull kelp (*Nereocystis*), which is an annual species, dying each winter. Kelp forests off central and southern California are comprised of giant kelp (*Macrocystis*), which is a perennial species. It can live for several years in deeper water, but can be removed by storms on exposed coasts.

3.3.1 Groundfish

This section presents some basic groundfish biology facts, starting with rockfish.

3.3.1 Groundfish

The Pacific Coast groundfish FMP manages more than 80 species. These species occur throughout the EEZ and occupy diverse habitats at all stages in their life history. While a few species have been intensively studied, there is relatively little information on the life history, habitat, and stock status of most groundfish species.

More detailed information about groundfish and other species can be found in Appendix A.

The life history, distribution, and stock status of each important groundfish species are summarized in Appendix A. More detailed information on the status of each of the groundfish species or species groups is available in the stock assessments associated with the annual SAFE report, as well as in the Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis for Proposed Groundfish ABC and OY Specifications and Management Measures for the 2002 Pacific Coast Groundfish Fishery.

This EIS highlights nine overfished groundfish stocks and 11 other groundfish stocks.

In addition to the individual species descriptions in Appendix A, generalized descriptions are provided below for the following groundfish species groups: rockfishes, thornyheads, gadids, flatfishes, sharks, and skates. These generalized descriptions are followed by information on the stock status for each *OVERFISHED* species and "*EMPHASIS SPECIES*." The term "overfished" describes a groundfish stock whose abundance is below its overfished/rebuilding threshold. Nine groundfish species are below the overfished threshold in 2003: bocaccio, canary rockfish, cowcod (south of Point Conception), darkblotched rockfish, lingcod, Pacific whiting, Pacific ocean perch, widow rockfish, and yelloweye rockfish. We are using the term "emphasis species" to describe a groundfish stock (other than an overfished stock) that is particularly relevant to bycatch issues and specifically incorporated in analyses of the alternatives in this EIS. Our groundfish emphasis species are black, yellowtail and chilipepper rockfish, shortspine and longspine thornyhead, sablefish, cabezon, English, Dover, and Petrale sole and arrowtooth flounder. The impacts of the alternatives described in Chapter 4 on these species should be representative of the impacts on species with similar life histories and distributions.

Generalized Rockfish (*Sebastes* spp.) Biology

Rockfish typically grow slowly, reproduce sporadically, and some live 100 years or longer. They have swim bladders that expand when the are caught and brought up from deep water. Nearly all die if that happens.

Sometimes depths are given in meters (m) and sometimes in fathoms (fm). A fathom equals 6 feet and 1.829 m. Thus, 1 fm is slightly less than 2 m.

Rockfishes are a very diverse group of over 55 species that occur along the West Coast. Adults of many species are most common in nearshore areas, whereas others (e.g., yellowtail rockfish) inhabit deeper waters on the shelf. Most rockfishes are demersal, often solitary, and associated with rocky areas or other structure. Adults of these species tend to remain in localized areas and do not undertake significant migrations or movements. A few others (e.g, widow rockfish) are considered pelagic, schooling species. All bear live young. Most species mate in the fall and larvae are released in spring, often in rocky or reef habitats. Larvae are carried inshore to rear during the summer and fall. Typically young-of-the-year are associated with vegetated and/or rocky areas and may occur in groups or larger schools. As they grow older, they adapt the adult lifestyle. Most rockfishes are slow-growing, long-lived and produce relatively few young each year. For most species, average age of maturity is reached between five and ten years. Some species are estimated to have a life span well over 50 years, perhaps 100 years, and the longevity of many species is 20 years or more. More detailed life histories for many rockfish species are provided in Appendix A.

Thornyheads are also in the rockfish family. They live on the bottom in deep water. The two species overlap, but longspine occur mostly deeper than shortspine.

Generalized Thornyhead Biology Two species of thornyheads occur off the West Coast, shortspine thornyhead (*Sebastolobus alascanus*) and longspine thornyhead (*S. altivelis*). They are found from Baja California to the Bering Sea and occasionally to Japan. They are common from southern California northward. Thornyheads are demersal and occupy soft bottoms in deep water. Their distributions overlap considerably although longspines also inhabit somewhat deeper waters. Off Oregon and California, shortspine thornyhead mainly occur between about 50 to 700 fm (100 and 1,400 m), most commonly from 50-500 fm (100-1,000 m), and longspine thornyhead mainly occur at depths of 200-700+ fm (400 - 1,400+m), most often between about 300-500 fm (600 -1,000 m) in the oxygen minimum zone. Off California, spawning occurs in February and March in deep water. Eggs rise to the surface to develop and hatch. Floating egg masses can be seen at the surface in March, April, and May. Larvae are pelagic for about 12-15 months. During January to June, juveniles settle onto the continental shelf and then move into deeper water as they become adults. Off California, shortspines begin to mature at 5 years; 50% are mature by 12-13 years; and all are mature by 28 years. Although it is difficult to determine the age of older individuals, they may live to over 100 years of age. Thornyheads eat a variety of invertebrates such as shrimps, crabs, and amphipods, as well as fishes and worms. Longspine thornyhead are a common item found in the stomachs of shortspine thornyhead and cannibalism of newly settled juveniles is important in the life history of thornyheads. Sablefish commonly prey on longspine thornyhead.

> "Flatfish" includes 12 species of flounders and soles. They are typically found on sandy bottom areas. Some species are shallower than others, and some make seasonal migrations from deep to shallow water.

Generalized Flatfish Biology Twelve species of *FLATFISHES* are classified as West Coast groundfish: arrowtooth flounder, butter sole, curlfin sole, Dover sole, English sole, flathead sole, Pacific sanddab, Petrale sole, rex sole, rock sole, sand sole, and starry flounder. (Pacific halibut and California halibut are not classified as West Coast groundfish, and are considered in Section 3.2.4 below.) Flatfish are demersal, inhabiting sandy, muddy, or gravelly bottoms from estuarine areas seaward over the shelf and onto the continental shelf. Starry flounder is common in estuarine areas and shallow nearshore areas and Dover sole and arrowtooth flounder are common on the outer shelf and slope. Others are most common nearshore and on the shelf. Individuals of the same species often occur together in large, non-random associations. Some may make extensive migrations, especially between feeding and spawning grounds. Spawning is most common during late winter and early spring. Except for rock sole, flatfish spawn many pelagic eggs, from hundreds of thousands to a few million, depending on species and size of the fish. Rock sole reportedly spawn over a variety of substrates, from rocky banks to sand and mud; their eggs are demersal and adhesive. For many species, eggs rise in the water column and are carried shoreward with the currents as they develop, although rex sole settle mainly on the outer continental shelf. As they age and grow, most flatfish move from shallow nursery areas into deeper waters. Age of maturity varies from 2 to 10 years, depending on species and sex. Longevity varies from 10 to 20 years with Dover sole living potentially twice as long. Juveniles and adults are carnivorous.

> "Gadid" means members of the cod family. Pacific whiting is the most abundant groundfish in the West Coast region.

Generalized Gadid Biology Two species of *GADIDS* are classified as groundfish off the West Coast: Pacific whiting

(*Merluccius productus*) and Pacific cod (*Gadus macrocephalus*). (Another gadid, walleye pollock, is not classified as a West Coast groundfish under the FMP, but its biology is described in Section 3.2.4 below.) Pacific Whiting, also known as Pacific hake, range from Sanak Island in the western Gulf of Alaska to Magdalena Bay, Baja California Sur. Off the West Coast, Pacific cod are at the southern end of their range, which extends from northern China along the Pacific rim to the Bering Sea and southward to Santa Monica, California. Smaller populations of cod and whiting occur in several of the larger semi-enclosed inlets, such as the Strait of Georgia and Puget Sound. Whiting are semi-pelagic. The highest densities of Pacific whiting are usually between 50 and 500 m, but adults occur as deep as 920 m and as far offshore as 400 km. Whiting school at depth during the day, then move to the surface and disband at night for feeding. Coastal stocks spawn off Baja California in the winter, then the mature adults begin moving northward and inshore, as far north as southern British Columbia by fall. They then begin the southern migration to spawning grounds and further offshore. Spawning occurs from December through March, peaking in late January. Their eggs are neritic and float to neutral buoyancy. Age of maturity for makes and females is three years and longevity is about 25 years. All life stages feed near the surface late at night and early in the morning. Juveniles and small adults feed chiefly on euphausiids. Large adults also eat amphipods, squid, herring, smelt, crabs, and sometimes juvenile whiting. Eggs and larvae of Pacific whiting are eaten by pollock, herring, invertebrates, and sometimes whiting. Juveniles are eaten by lingcod, Pacific cod and rockfish species. Adults are preyed on by sablefish, albacore, pollock, Pacific cod, marine mammals, soupfin sharks and spiny dogfish. The life history of Pacific cod off the West Coast differs in some aspects from the life history of Pacific whiting. Adult Pacific cod occur as deep as 875 m, but the vast majority occurs between 50 and 300 m. They are not considered to be highly migratory, but individuals can move long distances. Eggs are demersal, and eggs and larvae can be found over the continental shelf between Washington and central California from winter through summer. Most mature by 3 years of age, and longevity is about 15 years. Juveniles and adults are carnivorous and feed at night.

> Three species of sharks are classified as groundfish. These sharks bear live young and may live 30-70 years.

Generalized Shark Biology On the West Coast, three species of sharks are classified as groundfish: spiny dogfish, soupfin shark and leopard shark. (Other sharks off the West Coast are more oceanic and as an example, the biology of the common thresher shark is considered in Section 3.2.4 below.) Leopard shark inhabit nearshore waters, including shallow bays and estuaries in California; soupfin shark occur near bottom in nearshore areas and over the shelf; and spiny dogfish occur near bottom and at times, higher in the water column from inshore areas to the outer shelf. They are schooling species and may make long migrations. They bear live young, primarily during the spring. Leopard sharks can produce up to 36 pups; soupfin sharks average 35 pups and spiny dogfish produce up to 20 pups, although litters of 4-7 are common. The gestation period lasts for 10-12 months for leopard shark, but two years for spiny dogfish. Age at maturity also varies by species and sex, but is about 10 to 20 years for females. These sharks are long-lived, from 30 to 70 years, depending on species and sex.

> Three species of skates are classified as groundfish. They live on sandy bottom areas at various depths.

Generalized Skate Biology Three species of skates are classified as West Coast groundfish: big skate, California skate, and longnose skate. Adults inhabit mud or sand bottom on the shelf, although California skate is more common in shallower areas, especially off California. They are *OVIPAROUS*, with fertilization occurring internally, and eggs are deposited on the bottom in egg cases. Young hatch and inhabit level, sandy or muddy bottoms. Age of maturity ranges from six to12 years and adults live for 20-30 years.

> Lingcod is an overfished species that appears to be rebuilding quickly. They spawn in rocky reef areas during the winter, and male lingcod guard the eggs until they hatch. They do not have swim bladders, so many live if they are caught and released quickly and carefully.

Lingcod Biology Lingcod (*Ophiodon elongatus*), a top order predator of the family Hexagrammidae, ranges from Baja California to Kodiak Island in the Gulf of Alaska. Lingcod is *DEMERSAL* at all life stages. Adult lingcod prefer two main habitat types: slopes of submerged banks 10-70 m below the surface with seaweed, kelp and eelgrass beds and channels with swift currents that flow around rocky reefs. Juveniles prefer sandy substrates in estuaries and shallow subtidal zones. As the juveniles grow they move to deeper waters. Adult lingcod are considered a relatively sedentary species, but there are reports of migrations of greater than 100 km by sexually immature fish. Mature females live in deeper water than males and move from deep water to shallow water in the winter to spawn. Mature males may live their whole lives associated with a single rock reef, possibly out of fidelity to a prime spawning or feeding area. Spawning generally occurs over rocky reefs in areas of swift current. After the females leave the spawning grounds, the males remain in nearshore areas to guard the nests until the eggs hatch. Hatching occurs in April off Washington but as early as January and as late as June at the geographic extremes of the lingcod range. Males begin maturing at about 2 years (50 cm), whereas females mature at 3+ years (76 cm). In the northern extent of their range, fish mature at an older age and larger size. The maximum age for lingcod is about 20 years. Lingcod are a visual predator, feeding primarily by day. Larvae are zooplanktivores. Small demersal juveniles prey upon copepods, shrimps and other small crustaceans. Larger juveniles shift to clupeids and other small fishes. Adults feed primarily on demersal fishes (including smaller lingcod), squids, octopuses and crabs. Lingcod eggs are eaten by gastropods, crabs, echinoderms, spiny dogfish, and cabezon. Juveniles and adults are eaten by marine mammals, sharks, and larger lingcod.

Sablefish is one of the most valuable groundfish to the commercial fishery. They are widespread, both shallow and deep, north to south, and may migrate seasonally.

Sablefish Biology Sablefish (*Anoplopoma fimbria*) are abundant in the north Pacific, from Honshu Island, Japan, north to the Bering Sea, and southeast to Cedros Island, Baja California. There are at least three genetically distinct populations off the West Coast of North America: one south of Monterey characterized by slower growth rates and smaller average size, one that ranges from Monterey to the U.S./Canada border that is characterized by moderate growth rates and size, and one ranging off British Columbia and Alaska characterized by fast growth rates and large size. Large adults are uncommon south of Point Conception. Adults are found as deep as 1,000 fm (1,900 m), but are most abundant between 100-500 fm (200 and 1,000 m). Off southern California, sablefish were abundant to depths of 1,500 m. Adults and large juveniles commonly occur over sand and mud in deep marine waters. They were also reported on hard-packed mud and clay bottoms in the vicinity of submarine canyons. Spawning occurs annually in the late fall through winter in waters greater than 300 m. Sablefish are oviparous with external fertilization. Eggs hatch in about 15 days and are demersal until the yolk sac is absorbed. After yolk sac is absorbed, the age-0 juveniles become pelagic. Older juveniles and adults are benthopelagic. Larvae and small juveniles move inshore after spawning and may rear for up to four years. Older juveniles and adults inhabit progressively deeper waters. The best estimates indicate that 50% of females are mature at 5-6 years (24 inches), and 50% of males are mature at 5 years (20 inches). Sablefish larvae prey on copepods and copepod nauplii. Pelagic juveniles feed on small fishes and cephalopods, mainly squids. Demersal juveniles eat small demersal fishes, amphipods and krill. Adult sablefish feed on fishes like rockfishes and octopus. Larvae and pelagic juvenile sablefish are heavily preyed upon by sea birds and pelagic fishes. Juveniles are eaten by Pacific cod, Pacific halibut, lingcod, spiny dogfish, and marine mammals, such as

Orca whales. Sablefish compete with many other co-occurring species for food, mainly Pacific cod and spiny dogfish.

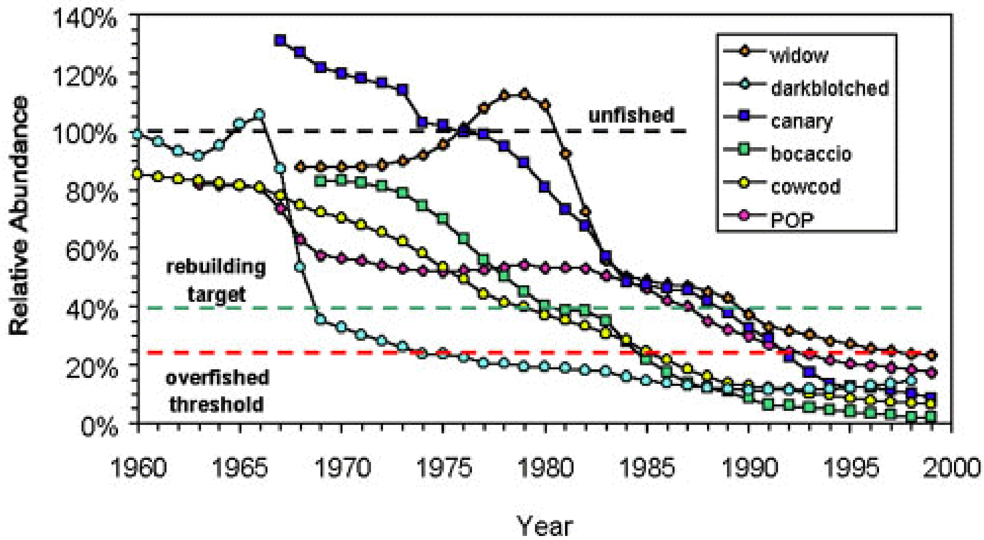
Cabezon is a type of sculpin that lives in shallow water.

Cabezon Biology Cabezon (*Scorpaenichthys marmoratus*) are found from central Baja California north to southeast Alaska. This species inhabits inshore waters from the intertidal out to depths of about 42 fm (76 m). It is most common at depths of 2.5 fm to 30 fm (5-59 m). Cabezon are found on rocky, sandy and muddy bottoms, and in kelp beds. They inhabit restricted home ranges. Age of maturity ranges from 3 to 6 years. Spawning takes place from late October to March in California, and from November through September in Washington. Fecundity ranges from 50,000 to 150,000 eggs, depending on size of the female. Eggs are deposited in clusters in shallow waters or in the low intertidal on bedrock, or in crevices. Males guard the nest after spawning and nest sites may be re-used from year to year. Eggs hatch two to three weeks after spawning. Small juveniles spend three to four months in the water column feeding on small crustaceans and other zooplankton. At about 1.5 inches (approximately 4 cm) they take up a demersal lifestyle. Adult cabezon primarily eat crustaceans (crabs, small lobster) but also mollusks (squid, octopus, abalone), smaller fishes, and fish eggs. Small cabezon are eaten by larger fishes including rockfishes, lingcod, adult cabezon, and other sculpins. Adults are eaten by pinnipeds.

Status of Overfished Groundfish Species

Nine groundfish species on the West Coast have been designated as overfished, based on estimates of their population abundance. A species is overfished if its abundance is less than 25% of its unfished population size. The rebuilding target for overfished species is 40% of its unfished population level. Historical estimates of relative abundance for seven rockfish species are shown in the Figure 3.2 (adapted from S. Ralston, personal communication). Trends in relative abundance of darkblotched rockfish, bocaccio and cowcod show relatively long, steady declines during the 1970s and 1980s to very low levels in1990s. Trends in relative abundance for Pacific ocean perch, widow rockfish and canary rockfish are more variable, but abundance generally declined during the late 1980s and through the1990s. More detailed information about the status of these species, including biomass estimates, are provided in Appendix A.

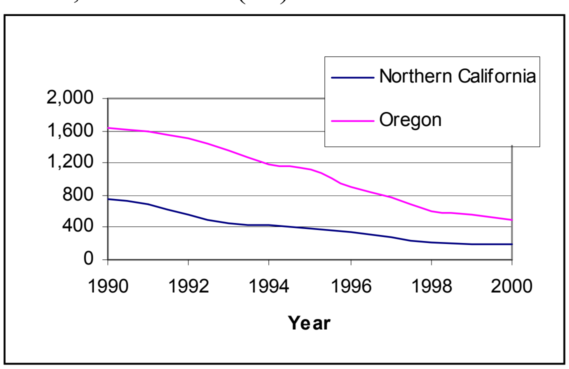
Figure 3.3. Some Key Overfished Groundfish Stocks.



Adopted from Steve Ralston; NOAA/NMFS/SW Fisheries Science Center

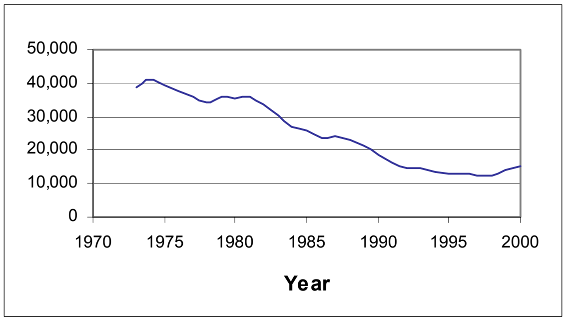
Yelloweye rockfish, lingcod and Pacific whiting have also been designated as overfished. Their population status is not incorporated in the previous figure, but is presented separately.

Figure 3.4. Yelloweye Rockfish Biomass Trend, 1990-2000 (mt).



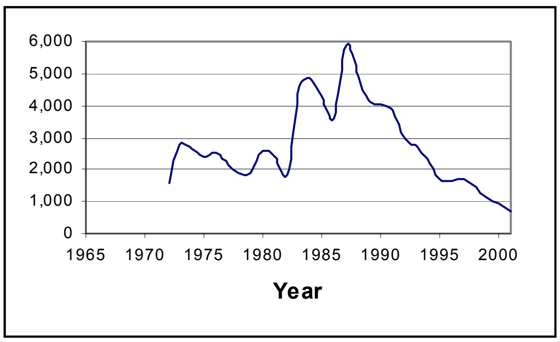
Yelloweye rockfish biomass show a steady decline during the 1990s (Figure 3.4). The population was considerably below the unfished level when assessed in 2001, although there is relatively little information about yelloweye rockfish and uncertainties remain in the assessment. Regulations have severely restricted landings of yelloweye rockfish in recent years.

Figure 3.5. Lingcod Population Biomass (mt, age 2+).



In 1997, lingcod was estimated to be at about 9% of its estimated unfished spawning potential (Figure 3.5). The estimated biomass of lingcod shows a decline from approximately 40,000 mt of fish, age 2 years and older, in the mid-1970s to a low of approximately 12,000 mt during the late 1990s.

Figure 3.6. Pacific Whiting Biomass, 1965 - 2000 (1,000 mt).



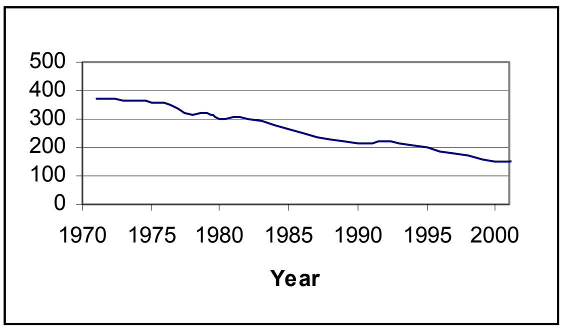
The abundance of whiting has been surveyed and assessed more frequently than for other groundfish species on the West Coast. Estimated biomass has declined fairly steadily from its historical peak of 5.7 million mt in 1987 to a low of about 1.7 million mt in recent years (Figure 3.6). A new stock assessment is in preparation (January 2004) and will be available by mid-2004. The whiting stock exhibits major, natural population size swings and the migratory nature of the stock is affected by ocean temperature. In cold water periods the stock tends to stay farther south nearer the spawning grounds off southern California. During warm periods, such as El Niño conditions, the stock migrates farther north into the area off Vancouver Island. Recent scientific studies indicate the Pacific Ocean off the West Coast of North America has undergone a shift to cooler conditions. This periodic environmental shift, known as the Pacific Decadal Oscillation, may result in a larger portion of the stock remaining within U.S. waters.

This section discusses the status of other highlighted groundfish species.

Status of Emphasis Groundfish Species

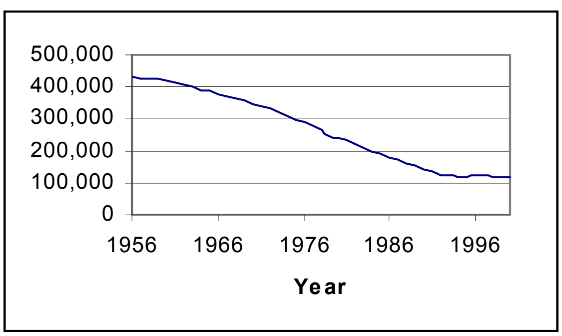
In addition to overfished species, eleven groundfish species are identified as "emphasis"species, those stocks that are particularly relevant to bycatch issues and specifically addressed in analysis of alternatives in this EIS. These species include sablefish, Dover sole, English sole, Petrale sole, arrowtooth flounder, chilipepper rockfish, yellowtail rockfish, shortspine thornyhead, longspine thornyhead, black rockfish and cabezon. Information about their population status is summarized below except for cabezon whose abundance has not been assessed. More detailed information about their life histories and population status is provided in Appendix A.

Figure 3.7. Sablefish Biomass trend, 1970-2000 (1,000 mt)



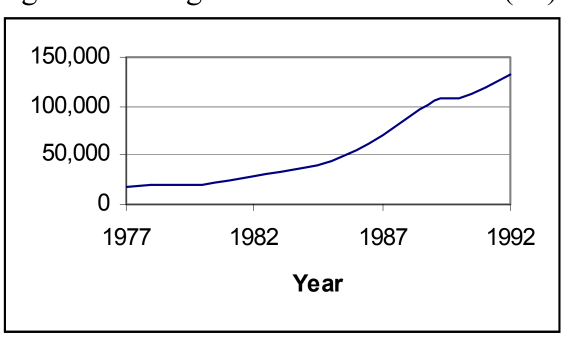
The estimated biomass of sablefish shows a slow, steady decline since the early 1970s (Figure 3.7). The stock is currently estimated to be between 27% and 38% of its unfished biomass and consequently, falls under "precautionary management" principles.

Figure 3.8. Dover Sole Biomass Trend, 1956-1996 (mt).



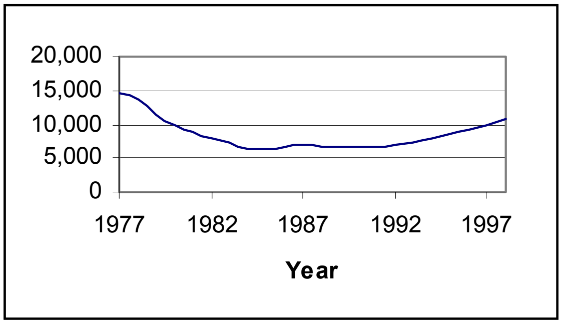
The most recent stock assessment for Dover sole completed in 2001 indicates that the current spawning stock size is about 29% of its unexploited biomass (Figure 3.8). Recent abundances appear to be without trend, but they were preceded by a steady decline since the late 1950s.

Figure 3.9. English sole biomass trend (mt).



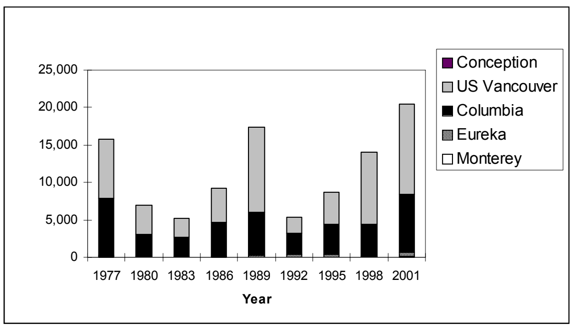
English sole has not been assessed since 1993. This assessment addressed English sole in northern areas (US Vancouver and Columbia) and indicated a nearly 7-fold increase in biomass since the 1970s to about 133,000 mt (Figure 3.9).

Figure 3.10. Petrale Sole Biomass Trend, 1977-1997.



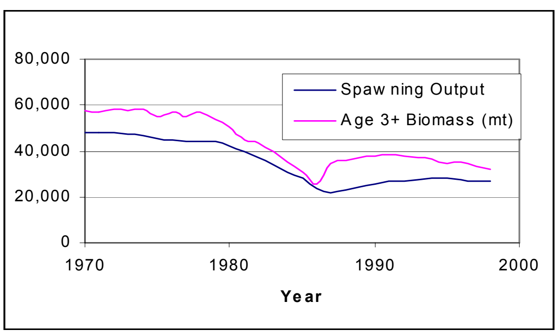
Petrale sole is currently estimated to be in excess of 39% of its unfished spawning biomass (Figure 3.10). The most recent assessment addressed the northern stock (US Vancouver and Columbia areas). Biomass appears to be stable or increasing after an initial fishing down process.

Figure 3.11. Arrowtooth Flounder Triennial Survey Biomass (mt).



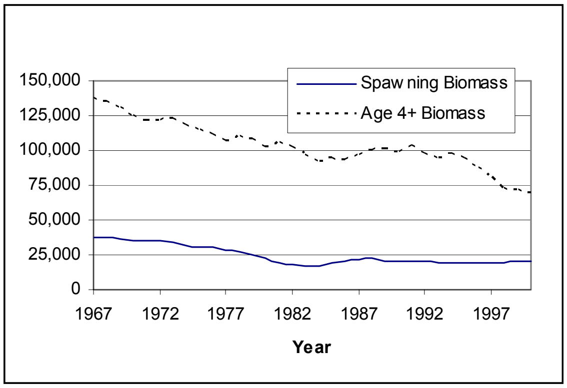
Arrowtooth flounder is at the southern end of its range in the Pacific region, and biomass off the West Coast appears to be highly variable, based on triennial trawl survey results (Figure 3.11). Most of the biomass occurs in the US Vancouver and Columbia areas, and a joint US/Canada assessment is recommended.

Figure 3.12. Chilipepper Rockfish Biomass Trend, 1970 - 2000.



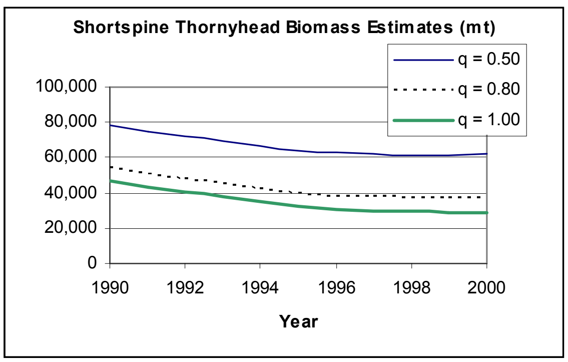
The most recent assessment of chilipepper rockfish in 1998 indicated a decline in biomass, but the stock remains above the target level (Figure 3.12). Chilipepper is managed as part of a complex, and regulations to protect bocaccio rockfish have probably reduced catches of chilipepper rockfish.

Figure 3.13. Yellowtail Rockfish Biomass Trend, 1967-1997 (mt).



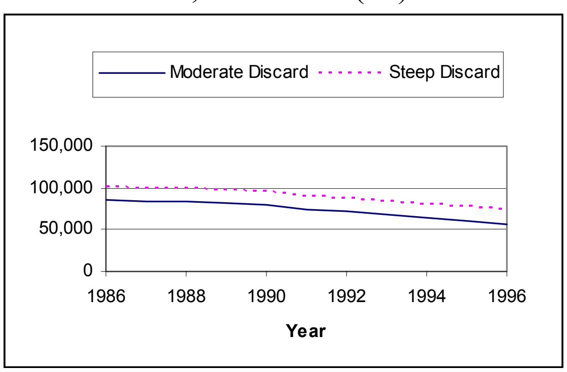
The most recent assessment for yellowtail rockfish in 2000 indicated that there has been a long-term decline in biomass, but the stock remains above the target level (Figure 3.13). Considerable uncertainty remains in the assessment, particularly over the relationship of yellowtail rockfish off the West Coast to those off Canada.

Figure 3.14. Shortspine Thornyhead Biomass Trend, 1990-2000 (mt).



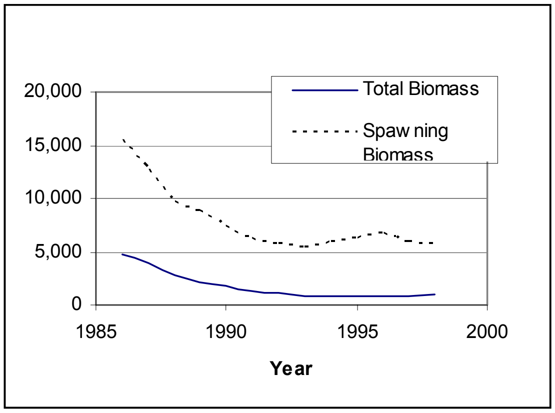
The most recent assessment for shortspine thornyhead in 2001 shows that the stock remains above the overfished level, between 24% and 48% of its unfished biomass (Figure 3.14). Considerable uncertainties remain in the assessments, particularly on the estimates of "q", the survey catchability coefficient.

Figure 3.15. Longspine Thornyhead Biomass Trend, 1990-2000 (mt).



Longspine thornyhead is estimated to be above 40% of its unfished biomass, according to the most recent assessment completed in 1997. One of the uncertainties in the assessment is the level of discard. The biomass trend is similar for both levels of discard, although estimated biomass is lower when a moderate level of discarding is assumed.

Figure 3.16. Black Rockfish Biomass Trend, 1985-2000 (mt).



The black rockfish stock off Washington and Oregon are above the target biomass level (Figure 3.16). Estimated spawning biomass and total biomass declined during the 1980s , but appear to remain relatively stable during the 1990s. However, major uncertainties remain in the assessment.

3.3.2 Other Relevant Fish, Shellfish and Squid

3.3.2 Other Relevant Fish, Shellfish and Squid

We have selected twelve non-groundfish species (excluding protected species described in Section 3.3.3 below), identified as "emphasis species," to capture the impacts of the alternatives. These twelve species are Pacific halibut, California halibut, pink shrimp, spot prawn, ridgeback prawn, Dungeness crab, jack mackerel, Pacific mackerel, walleye pollock, common thresher shark, and eulachon. These species represent the range of impacts likely experienced by a broader range of species, but with similar life histories, distributions, and vulnerabilities to bycatch impacts. Life histories of emphasis species are summarized below and more detailed descriptions, including available information on stock status, are given in Appendix A. Similar descriptions are also provided in Appendix A for seven additional species that likely experience similar impacts of the Alternatives. These seven are blue shark, shortfin Mako shark, Pacific angel shark, Pacific herring, longfin smelt, night smelt, and surf smelt.

These 12 non-groundfish have been selected to represent other fish species in order to illustrate the impacts of the alternatives.

Pacific Halibut (*Hippoglossus stenolepis*) ranges from California to the Bering Sea and extends into waters off Russia and Japan. The International Pacific Halibut Commission (IPHC) is responsible for Pacific halibut in the Northeast Pacific ocean. Pacific halibut are demersal and inhabit sand and gravel bottoms, especially banks, on the continental shelf. Halibut from California through the Bering Sea are considered to form one homogeneous population. Halibut off the West Coast are at the extreme southern end of their range and those that inhabit West Coast waters result from the southerly migration of

Pacific halibut are large flatfish that mostly live north of the West Coast. Most are born off Alaska or Canada and migrate to this area. Most found off the West Coast are adults.

juveniles. Halibut spawn during the winter in deep water (1,000 feet or 300 m). Their eggs and larvae rise and drift great distances with the ocean currents in a counter-clockwise direction around the northeast Pacific Ocean. Young fish settle to the bottom in shallow feeding areas. After two or three years, young halibut tend to counter-migrate to more southerly and easterly waters. Adult fish tend to remain on the same grounds year after year, making only a seasonal migration from the more shallow feeding grounds in summer to deeper spawning grounds in the winter. Pacific halibut are large, up to about 500 pounds (227 kg). Females typically grow faster and live longer than males; nearly all halibut over 100 pounds (45 kg) are females. Age of maturity for females is approximately 12 years. Most halibut are less than 25 years old. Halibut are carnivorous. Adults prey upon cod, sablefish, pollock, rockfishes, sculpins, turbot, and other flatfish. They also leave the bottom to feed on sand lance and herring in the water column. Octopus, crabs, clams, and occasionally small halibut are also eaten. Large juvenile and adult halibut are occasionally eaten by marine mammals but are rarely prey for other fish.

California halibut is another large flatfish that live mostly off central to southern California in relatively

California Halibut (*Paralichthys californicus*) range from the Quillayute River, Washington to Almejas, Baja California, but their abundance and commercial fishery in U.S. waters are concentrated from Bodega Bay to San Diego, California. California Dept. of Fish and Game (CDFG) manages fisheries for California halibut off its coast; little fishing and catch occurs off Oregon and Washington. Adults live on soft bottom habitats in coastal water generally less than 300 feet (91 m) deep, with greatest abundance at depths less than 100 feet (30 m). California halibut live up to 30 years and reach 60 inches (153 cm). Male halibut mature at one to three years of age and eight to twelve inches (20 - 30 cm), whereas females mature at four to five years and 15 to 17 inches (38 - 43 cm). Adults spawn throughout the year with peak spawning in winter and spring. Pelagic eggs and larvae drift over the shelf but are in greatest densities within four miles of shore. Newly settled and larger juvenile halibut are usually found in unvegetated shallow-water bays. Juveniles emigrate from the bays to the coast at about one year of age and 6.9 to 8.7 inches (17.5 - 22 cm). Adult California halibut primarily prey upon Pacific sardine, northern anchovies, squid, and white croaker. Small juvenile halibut eat primarily crustaceans.

Shrimp and prawns eaten by groundfish and other species. Fisheries for shrimp and prawns often catch groundfish.

Pink shrimp (*Pandalus jordani*), also called ocean shrimp, occur from the Aleutian Islands to San Diego, California. State agencies plus the Washington treaty tribes manage the pink shrimp resource and fisheries off their respective coasts. Pink shrimp occur at depths from 150 to 1,200 feet (46 - 366 m) but are generally found at depths from 240 to 750 feet (73 - 229 m). Concentrations of shrimp remain in well-defined areas or beds from year to year. These areas are associated with green mud and muddy-sand bottoms. Most pink shrimp spend the first year and a half of life as males, then pass through a transitional phase to become females. Pink shrimp adjust their sex ratio to fluctuating age distributions. Mating takes place during September and October. Fertilization takes place when the females begin extruding eggs in October. Females usually carry between 1,000 and 2,000 eggs until the larvae hatch in March and April. The larval period lasts 2½ to three months. Developing juvenile shrimp occupy successively deeper depths, and often begin to show in commercial catches by late summer. Pink shrimp grow in steps by molting or shedding their shells and growth rates vary by region, season, sex and year class. Pink shrimp feed mainly at night on planktonic animals, such as euphausiids and copepods. Many species of fish prey on pink shrimp, including Pacific whiting, arrowtooth flounder, sablefish, petrale sole and several species of rockfish. Predation by whiting may affect the abundance of pink shrimp.

Spot Prawn (*Pandalus platyceros*) ranges from the Aleutian Islands to San Diego, California, and extends to the Sea of Japan and the Korea Strait. Spot prawns are typically found at depths between 653 and 772 feet (198-234 m). Juvenile shrimp concentrate in shallower, inshore areas (<297 feet or 90m) and migrate offshore as they mature. Spot prawn distribution is very patchy and related to water temperature, salinity and physical habitat. Spot prawns typically inhabit rocky or hard bottoms, including reefs, coral or glass-sponge beds, and the edges of marine canyons. Spot prawns can live up to six years off California but longevity decreases in more northerly areas; the average age off Canada is only four years. Spot prawns change sex in midlife. They mature first as males, mate, and then change to females after a transition phase. Sexual maturity is reached during the third year (about 1.5 inches or 38 mm carapace length). By the fourth year (about 1.75 inches or 44 mm carapace length), many males begin to change sex to the transitional stage. By the end of the fourth year, the transitionals become females. Each individual mates once as a male and once or twice as a female. Spawning occurs once each year, typically in late summer or early autumn. Spawning takes place at depths of 500 to 700 feet (151-212 m). Females carry eggs for a period of four to five months before they hatch. Spot prawns produce a few thousand eggs. Eggs hatch over a 10-day period and is completed by April. The larvae spend up to three months in the water column and then begin to settle out at shallow depths. Spot prawns typically feed on other shrimp, plankton, small mollusks, worms, sponges and fish carcasses. They usually forage on the bottom throughout the day and night.

Ridgeback prawn is primarily a southern California species that lives at depths of about 30 - 90 fm.

Ridgeback Prawn (*Sicyonia ingentis*) occurs from Monterey, California, to Cedros Island, Baja California. They inhabit depths ranging from less than 145 feet to 525 feet (44 - 160 m). Major concentrations occur in the Ventura-Santa Barbara Channel area, Santa Monica Bay, and off Oceanside. Other pockets of abundance occur off Baja California. Ridgeback prawns inhabit substrates of sand, shell and green mud. Because they are relatively sessile, little or no intermixing occurs. Their maximum life span is five years and sexes are separate. Females reach a maximum carapace length of 1.8 inches (46 mm) and males 1.5 inches (38 mm). Ridgeback prawns are free spawners, in contrast to other shrimps which carry eggs. Both sexes spawn as early as the first year, but most spawn during the second year at a size of 1.2 inches (30 mm). On average, females produce 86,000 eggs. Following spawning, both sexes undergo molting. The food habits of the ridgeback prawn are unknown, but it may feed on detritus like closely related species. Likely predators include rockfish, lingcod, octopus, sharks, halibut, and bat rays.

Dungeness Crab occur from Alaska to Mexico, typically on sandy bottom in relatively shallow water.

Dungeness Crab (*Cancer magister*) and their respective fisheries are managed by the West Coast states and Washington treaty tribes. Dungeness occur in coastal waters along North America from Unalaska Island to Magdalena Bay, Mexico. They are widely distributed over sandy or muddy bottom, generally in waters shallower than 90 feet (27.4 m), but they have been found as deep as 600 feet (183 m). Crabs grow each time they molt. Juveniles molt 11 or 12 times prior to sexual maturity, which may be reached at three years. At four to five years, a Dungeness crab can be over 6.5 inches (16.5 cm) in carapace width and weigh between 2 and 3 pounds (0.9 - 1.4 kg). The estimated maximum life span is between 8 and 13 years. Males mate only with female crabs that have just molted, from spring through fall. A large female crab can carry 2.5 million eggs under her abdomen until hatching. Young planktonic crabs go through six developmental stages before they molt into their first juvenile stage. After molting, the juveniles inhabit shallow coastal waters and estuaries with large numbers living among eelgrass or other habitats with aquatic vegetation. Shell hash is also important habitat for young Dungeness crabs. Dungeness crabs scavenge along the sea floor and their diet includes shrimp, mussels, small crabs, clams, and worms. Cannibalism is common. Young planktonic crabs are important prey for salmon and other fishes. Juveniles are eaten by a variety of fishes in the nearshore area, especially starry flounder, English sole, rock sole, lingcod, cabezon, skates and wolf eels. Octopus may also be an important predator.

Market squid are small, short-lived molluscs that grow to about 12 inches (30 cm) total length, including arms. Most mature and spawn when about one year old, then die. Spawning squid concentrate in dense schools.

Market Squid (*Loligo opalescens*) is a coastal pelagic species (CPS) managed by the Council. They occur throughout the California and Alaska current systems from the southern tip of Baja California, Mexico, to southeastern Alaska. Market squid are most abundant from Punta Eugenio, Baja California and Monterey Bay, California. Although generally considered pelagic, they are found over the continental shelf from the surface to depths of at least 2,625 feet (800 m). Adults and juveniles are most abundant between temperatures of 10 °C and 16° C. Market squid are small, short-lived molluscs reaching a maximum size of 12 inches (30 cm) total length, including arms. Most mature and spawn when about one year old, then die. Spawning along the West Coast occurs year-round. Spawning squid concentrate in dense schools. Known major spawning areas are shallow semi-protected nearshore areas with sandy or mud bottoms adjacent to submarine canyons. In these locations, egg deposition occurs between 1.5 and 17 feet (5-55 m). Females produce 20 to 30 capsules and each capsule contains 200 to 300 eggs. Females attach each egg capsule individually to the substrate. As spawning continues, mounds of egg capsules covering more than 100 square meters (1076 sq. ft.) may be formed. Hatchlings are dispersed by currents, and their distribution after leaving the spawning areas is largely unknown. Market squid are important forage to a long list of fish, birds, and mammals. Some of the more important squid predators are chinook salmon, coho salmon, lingcod, rockfish, harbor seals, California sea lions, sea otters, elephant seals, Dall's porpoise, sooty shearwater, Brandt's cormorant, rhinoceros auklet and common murre.

Jack mackerel was previously managed as a groundfish, but now is in the CPS FMP. Older fish sometimes are found north of California.

Jack Mackerel (*Trachurus symmetricus*) is a coastal pelagic species (CPS) managed by the Council. It is a widely distributed, schooling fish throughout the northeastern Pacific Ocean and much of their range lies outside the EEZ. Young fish, up to six years old, are most abundant in the Southern

California Bight and school over shallow rocky banks. Older fish, 16 to 30 years old are generally found offshore in deep water and along the coastline to the north of Point Conception. They are more available on offshore banks in late spring, summer, and early fall than during the remainder of the year. They remain near the bottom or under kelp canopies during daylight and move into deeper nearby areas at night. Young juveniles sometimes are found in small schools beneath floating kelp and debris in the open ocean. Jack mackerel live 35 years or more. Half or more of all females reach sexual maturity during their first year of life. The spawning season for jack mackerel off California extends from February to October, with peak activity from March to July. Larval jack mackerel feed almost entirely on copepods. Small jack mackerel off southern California eat large zooplankton, juvenile squid, and anchovy. Large mackerel offshore primarily prey upon euphausiids, but also on small fishes. Large predators, such as tuna and billfish, and some marine mammals, like seals and sea lions, prey upon jack mackerel.

> Pacific mackerel is primarily a southern species but may range north to the central Oregon coast, especially in warm water years.

Pacific (Chub) Mackerel (*Scomber japonicus*) is a coastal pelagic species (CPS) and one of three spawning stocks along the Pacific coasts of the US and Mexico. Only the northeastern Pacific stock extending northward from Punta Abreojos, Baja California is harvested by US fishers and managed by the Council. This stock is common from Monterey Bay to Cabo San Lucas. Pacific mackerel usually occur within 20 miles of shore, but have been taken as far offshore as 250 miles. Adults inhabit water ranging from 10°C to 22.2°C and they may move north in summer and south in winter between Tillamook, Oregon and Magdalena Bay, Baja California. They are found from the surface to depths of 300 meters and commonly occur near shallow banks. Juveniles are found off sandy beaches, around kelp beds, and in open bays. Larvae are found in water around 14°C. Pacific mackerel often school with other pelagic species, particularly jack mackerel and Pacific sardine. Pacific mackerel may reach 63 cm in length and 11 years in age. Age of maturity is two to four years. Spawning peaks from late April to July. Juvenile and adult Pacific mackerel prey upon small fish, fish larvae, squid and pelagic crustaceans. Juveniles and adults are eaten by larger fish, marine mammals, and seabirds. Pacific mackerel larvae are preyed upon by a number of invertebrate and vertebrate planktivores.

> Pollock are not common off the West Coast of the U.S., but sometimes the population expands into this region. They live near the bottom on the shelf and slope.

Walleye Pollock (*Theragra chalcogramma*) are found in the waters of the Northeastern Pacific Ocean from the Sea of Japan, north to the Sea of Okhotsk, east in the Bering Sea and Gulf of Alaska, and south along the Canadian and U.S. West Coast to Carmel, California. Adult walleye pollock are generally semi-demersal species on continental shelf and slope. A variety of environmental factors, including hydrographic fronts, temperature, light intensity, prey availability, and depth determine the distribution of juveniles and adults. They are not common off the West Coast, but occasionally sufficiently large enough numbers move south from Canadian waters to be targeted by West Coast commercial fishers. Adults most commonly occur between 100 and 300m. Most pollock are mature by age three. Spawning takes place at depths of 50 to 300m. Walleye pollock are oviparous and females spawn several batches of eggs, usually in deep water over a short period of time. Eggs are pelagic and are found throughout the water column. Larvae and juveniles are pelagic, and are generally found in the upper water column to depths of 60m. Adults are carnivorous and feed primarily on euphausiids, small fishes, copepods, and amphipods. In some areas, cannibalism can be an important food source for adults.

Thresher shark is a large pelagic species that migrates seasonally from southern California to Oregon and Washington.

Common Thresher Shark (*Alopias vulpinus*) is a highly migratory species (HMS). It is a large pelagic shark with a circumglobal distribution. In the northeastern Pacific, it occurs from Goose Bay, British Columbia south to Baja California. Abundance is thought to decrease rapidly beyond 40 miles from the coast, although catches off California and Oregon do occur as far as 100 miles offshore. This species is often associated with areas of high biological productivity, strong frontal zones separating regions of upwelling and adjacent waters, and strong horizontal and vertical mixing of surface and subsurface waters. They may migrate north-south seasonally between San Diego/Baja Mexico and Oregon and Washington. Large adults may pass through southern California waters in early spring of the year, remaining in offshore waters from one to two months for pupping. Pups are then thought to move into shallow coastal waters. Adults then continue to follow warming water and perhaps prey northward, and by late summer, arrive off Oregon and Washington. Subadults appear to arrive in southern California waters during the early summer, and as summer progresses move up the coast as far north as San Francisco, with some moving as far as the Columbia River. In the fall, these subadults are thought to move south again. Little is known about the presumed southward migration of the large adults, which do not appear along the coast until the following spring. The common thresher shark bears live young, usually 2-4 pups.

Birth is believed to occur in the spring months off California. Size and age of first maturity for females is likely between 8.5-9 feet (260-270 cm) and about 4 or 5 years old. For males, size and age of first maturity is between 8-11 feet (246-333 cm) and 3 to 6 years. This species has been variously reported to reach a maximum age of from 19 to 50 years old. Primary prey items in the diet of the common thresher shark taken in the California-Oregon drift gillnet fishery included anchovy, sardine, Pacific whiting, mackerels, shortbelly rockfish, and market squid.

Eulachon is a type of smelt that migrates from the ocean into fresh water to spawn.

Eulachon (*Thaleichthys pacificus)* range from central California to Alaska. Off the West Coast, eulachon are managed by the respective states. Eulachon are anadromous, spending most of their life in the open ocean, schooling at depths of 150 to 750 feet (46 - 229 m). They migrate to lower reaches of coastal rivers and streams to spawn in fresh water; the largest run occurs in the Columbia River, where occasionally they travel over 100 miles upriver. Eulachon may live up to five years and reach 12 inches (30.5 cm) in length. Most eulachon reach maturity in two to three years and die after spawning. Each female lays about 25,000 eggs which stick to the gravel and hatch in two to three weeks. Upon hatching, larvae begin migrating to the sea. Eulachon feed mainly on euphasiids, copepods and other crustaceans, and they are a very important food for predatory marine animals, including salmon, halibut, cod and sturgeon.

3.3.3 Protected Species

3.3.3 Protected Species

Several species of marine mammals, seabirds, sea turtles and salmon on the West Coast have been listed as threatened or endangered under the ESA. A species is listed as "*ENDANGERED*" if it is in danger of extinction throughout a significant portion of its range and "*THREATENED*" if it is likely to become an endangered species within the foreseeable future throughout all, or a significant portion, of its range. The following species (Table 3.3.1) are subject to the conservation and management requirements of the ESA.

In addition to these federally protected species, California lists several seabirds as endangered or species of special concern under the California Endangered Species Act. These include brown pelican, marbled murrelet, Xanthus murrelet, rhinoceros auklet, and tufted puffin.

Some of these species and other marine mammals and seabirds are taken incidentally in West Coast groundfish fisheries and are therefore, especially relevant to bycatch issues. They are termed "emphasis species" (or species groups) for purposes of discussion of the Alternatives in Chapter 4 and include 6 marine mammals, 4 seabirds and 2 salmon species. The marine mammals are Stellar sea lion, California sea lion, northern elephant seal, harbor seal, Dall's porpoise and Pacific white-sided Dolphin. Although more than 100 species of seabirds occur along the West Coast, little information is available about the incidental take of seabirds by West Coast groundfish fisheries. Observers aboard groundfish vessels off the West Coast during August 2001-October 2002 reported four cormorants and one gull were taken by the limited entry trawl fleet. To approximate the impact of Alternatives in Chapter 4, it is assumed that any species taken by West Coast longline fisheries will be similar to the incidental takes by Alaskan longliners, for which some information is available. Seabirds taken by Alaska longliners, and considered "emphasis species" are northern fulmars, gulls, Laysan albatross, and black-footed albatross. No sea turtles are included as "emphasis species" because there is minimal take by West Coast fisheries for groundfish. Chinook (king) and coho (silver) salmon are included as emphasis species.

Table 3.3.1. West Coast Endangered Species

Marine Mammals
Threatened: • Steller sea lion (*Eumetopias jubatus*) Eastern Stock, • **Guadalupe fur seal (*Arctocephalus townsendi*), and** • **Southern sea otter (*Enhydra lutris*) California Stock.**
Seabirds
Endangered: • **Short-tail albatross (*Phoebastria (=Diomedea) albatrus*),** • **California brown pelican (*Pelecanus occidentalis*), and** • **California least tern (*Sterna antillarum browni*).** **Threatened:** • **Marbled murrelet (*Brachyramphs marmoratus*).**
Sea Turtles
Endangered: • **Green turtle (*Chelonia mydas*)** • **Leatherback turtle (*Dermochelys coriacea*)** • **Olive ridly turtle (*Lepidochelys olivacea*)** **Threatened:** • **Loggerhead turtle (*Caretta caretta*)**
Salmon
Endangered: • **Chinook salmon (*Oncorhynchus tshawytscha)*** Sacramento River Winter; Upper Columbia Spring • **Sockeye salmon (*Oncorhynchus nerka)*** Snake River • **Steelhead trout (*Oncorhynchus mykiss)*** Southern California; Upper Columbia **Threatened:** • **Coho salmon (*Oncorhynchus kisutch)*** Central California, Southern Oregon, and Northern California Coasts • **Chinook salmon (*Oncorhynchus tshawytscha*)** Snake River Fall, Spring, and Summer; Puget Sound; Lower Columbia; Upper Willamette; Central Valley Spring; California Coastal • **Chum salmon (*Oncorhynchus keta)*** Hood Canal Summer; Columbia River • **Sockeye salmon (*Oncorhynchus nerka)*** Ozette Lake • **Steelhead trout (*Oncorhynchus mykiss)*** South-Central California, Central California Coast, Snake River Basin, Lower Columbia, California Central Valley, Upper Willamette, Middle Columbia, Northern California

Life histories are described below for each of these emphasis species. More detailed information is provided in Appendix A, as well as descriptions for other marine mammals, sea birds, and sea turtles that occur on the West Coast.

Sea lions and seals occur off the West Coast.

Steller (Northern) Sea Lion *(Eumetopias jubatus*) range along the North Pacific Ocean from Japan to California. Two stocks are designated in U.S. waters with the eastern stock extending from Cape Suckling, Alaska to southern California with a total of 6,555 animals off Washington, Oregon and California. They do not make large migrations, but disperse after the breeding season (late May-early July), feeding on rockfish, sculpin, capelin, flatfish, squid, octopus, shrimp, crabs, and northern fur seals.

California Sea Lion *(Zalophus californianus)* range from British Columbia south to Tres Marias Islands off Mexico. Breeding grounds are mainly on offshore islands from the Channel Islands south into Mexico. Breeding takes place in June and early July within a few days after the females give birth. The population is estimated at 214,000 sea lions. During the summer breeding season, most adults are present near rookeries principally located on the southern California Channel Islands and Año Nuevo Island near Monterey Bay. Males migrate northward in the fall, going as far north as Alaska and returning to their rookeries in the spring. Adult females generally do not migrate far away from rookery areas. Juveniles remain near rookery areas or move into waters off central California. Diet studies indicate that California sea lions feed on squid, octopus, and a variety of fishes: anchovies, sardine, mackerel, herring, rockfish, Pacific whiting, and salmon.

Harbor Seal *(Phoca vitulina richardsi*) inhabit nearshore and estuarine areas ranging from Baja California, Mexico, to the Pribilof Islands, Alaska. MMPA stock assessment reports recognize six stocks along the U.S. West Coast: California, Oregon/ Washington outer coastal waters, Washington inland waters, and three stocks in Alaska coastal and inland waters. The California stock is estimated at 30,293 seals; the Oregon/ Washington Coast stock at 26,180 seals; and the Washington inland-water stock at 16,056 seals. Harbor seals do not migrate extensively, but have been documented to move along the coast between feeding and breeding locations. The harbor seal diet includes herring, flounder, sculpin, cephalopods, whelks, shrimp, and amphipods.

Several species of porpoises occur off the West Coast.

Dall's Porpoise *(Phocoenoides dalli*) are common in shelf, slope and offshore waters in the north eastern Pacific Ocean down to southern California. As a deep water oceanic porpoise, they are often sighted nearshore over deepwater canyons. These porpoise are abundant and widely distributed with at least

50,000 off California, Oregon, and Washington; however because of their behavior of approaching vessels at sea, it may be difficult to obtain an unbiased estimate of abundance. Dall's porpoise calf between spring and fall after a 10-11 month gestation period. North-south movement between California, Oregon and Washington occurs as oceanographic conditions change, both on seasonal and inter-annual time scales. Dall's porpoise feed on squid, crustaceans, and many kinds of fish including jack mackerel.

Harbor Porpoise *(Phocoena phocoena*) are small and inconspicuous. They range in nearshore waters from Point Conception, California into Alaska and do not make large scale migrations. Harbor porpoise in California are split into two separate stocks based on fisheries interactions: the central California stock, Point Conception to the Russian River, and the northern California stock in the remainder of northen California. Oregon and Washington harbor porpoise are combined into a coastal stock and there is designated an inland Washington stock for inland waterways. The most recent abundance estimates, based on aerial surveys are: central California 7,579; northern California 15,198; Oregon/ Washington coastal 44, 644; and inland Washington 3,509 harbor porpoise. There are no clear trends in abundance for these stocks. Harbor porpoise are not listed as threatened or endangered under the ESA nor as depleted under the MMPA. The average annual mortality for 1996-99 (80 harbor porpoise) is greater than the calculated Potential Biological Removal (56) for central California harbor porpoise; therefore, the central California harbor porpoise population is strategic under the MMPA. Although usually found in nearshore waters, distinct seasonal changes in abundance along the West Coast have been noted, and attributed to possible shifts in distribution to deeper offshore waters during late winter. The harbor porpoise diet is comprised mainly of cephalopods and fishes and they prefer schooling non-spiny fishes, such as herrings, mackerels, and sardines. Harbor porpoise are very susceptible to incidental capture and mortalities in setnet fisheries. Off Oregon and Washington, fishery mortalities of harbor porpoise have been recorded in the northern Washington marine set and drift gillnet fisheries.

Pacific White-Sided Dolphin (*Lagenorhynchus obliquidens*) are abundant, gregarious and found in the cold temperate waters of the North Pacific Ocean. Along the West Coast of north America they are rarely observed south of Baja California, Mexico. Aerial surveys have exceeded 100,000 white-sided dolphins over the California continental shelf and slope waters. Little is known of their reproductive biology. Longevity is not known although a 29- year-old pregnant female has been reported. White-sided dolphins inhabit California waters during winter months moving northward into Oregon and Washington during spring and summer. Shifts in abundance likely represent changes in prey abundance or migration of prey species. They are opportunistic feeders and often work collectively to concentrate and feed small schooling fish including anchovies, Pacific whiting, herrings, sardines, and octopus.

Short-Beaked Common Dolphin *(Delphinus delphis)* commonly inhabit tropical and warm temperate oceans. Their distribution along the U.S. West Coast extends from southern California to Chile and westward to 135° West longitude. The 1991-96 weighted average abundance estimate for California, Oregon and Washington waters based on three ship surveys is 373,573 short-beaked common dolphins. They are not endangered or threatened under the ESA nor depleted under the MMPA. The stock is not listed as strategic under the MMPA and total human-caused mortality (79) is less than the 3,188 dolphins allowed under the Potential Biological Removal formula. Reproductive activity is non-seasonal in tropical waters with peaked calving in spring and summer in more temperate waters. Short-beaked common dolphins feed nearshore on squid, octopus and schooling fish like anchovies, hake, lantern fish, deep-sea smelt or herring. These dolphins are often seen in very large schools of hundreds or thousands and are active bow riders. Common dolphin mortality has been estimated for set gillnets in California; however, the two species (short-beaked and long-beaked) were not reported separately. Short-beaked common dolphins have been reported as a bycatch in some trawl fisheries.

Long-Beaked Common Dolphin *(Delphinus capensis)* were recognized as a distinct species in 1994. Their distribution overlaps with the short-beaked common dolphin, although they are more typically observed in nearshore waters. The 1991-96 weighted average abundance estimate for California, Oregon and Washington waters based on three ship surveys is 32,239 long-beaked common dolphins. They are not endangered or threatened under the ESA nor depleted under the MMPA. The stock is not listed as strategic under the MMPA and total human-caused mortality (14) is less than the 250 dolphins allowed under the Potential Biological Removal formula. Reproductive activity is similar to short-beaked: non-seasonal in tropical waters with peaked calving in spring and summer in more temperate waters. Long-beaked common dolphins feed nearshore on squid, octopus and schooling fish like anchovies or herring. They are also active bow riders and break the water surface frequently when swimming in groups averaging 200 animals. Common dolphin mortality has been estimated for set gillnets in California; however, the two species (short-beaked and long-beaked) were not reported separately. Long-beaked common dolphins have been reported as a bycatch in some trawl fisheries.

Northern Elephant Seal *(Mirounga angustirostris*) range from Mexico to the Gulf of Alaska. Breeding and whelping occurs in California and Baja California, during winter and early spring on islands and recently at some mainland sites. The population was estimated at 127,000 elephant seals in the U.S. and Mexico during 1991. The population is growing and fishery mortality may be declining, and the number of pups born may be leveling off in California during the last five years.

Northern elephant seals are polygynous breeders with males forming harems and defending them against other mature males in spectacular battles on the beach. Female give birth in December and January, mate about three weeks later, after which the pups are weaned. They feed mainly at night in very deep water to consume whiting, skates, rays, sharks, cephalopods, shrimp, euphasiids, and pelagic red crab. Males feed in waters off Alaska, and females off Oregon and California.

Many species of seabirds occur off the West Coast. Some are resident and some migrate through the region. Some are listed under the Endangered Species Act.

Black-Footed Albatross (*Phoebastria nigripes*) ranges throughout the North Pacific. Breeding occurs on northwestern Hawaiian Islands and Torishima Island and the species disperses from the Bering Sea south along the Pacific Coast to California. Black-footed albatross is the most numerous albatross species along the Pacific Coast and is present throughout the year. The global black-footed albatross population is estimated at about 56,500 breeding pairs and thought to be decreasing. Black-footed albatross fed on fish, sea urchins, amphipods, and squid; foraging is done at night and prey is caught at the ocean's surface. This species will also follow fishing vessels and feed on discard.

Laysan Albatross (*Phoebastria immutabilis*) is the most abundant North Pacific albatross species. The vast majority of the Laysan albatross population breeds on the northwestern

Hawaiian Islands, fewer numbers breed on the Japanese Ogasawara Islands, and still fewer pairs breed on islands off Baja California, Mexico (Guadalupe Island, Alijos Rocks, and in the Revillagigedo Islands). When at sea, the Laysan albatross ranges from the Bering Sea, to California, to Japan. Surveys at three sites indicate breeding populations total about 400,000 breeding pairs, but this represents an average decline of 3.2% per year since 1992. Laysan albatross feed on schooling fish and squid at the ocean's surface.

Cormorants that occur along the Pacific Coast include Brandt's cormorant (*Phalacrocorax penicillatus*), double-crested cormorant (*Phalacrocorax auritus*), and pelagic cormorant (*Phalacrocorax pelagius*). Brandt's cormorants are by far the most abundant cormorant species nesting along the coast of Oregon and California. Brant's cormorants are typically found in inshore, coastal areas, especially in areas having kelp beds, brackish bays, sheltered inlets, and quiet bays. Brandt's cormorant usually nests on offshore islands or, less frequently, on inaccessible mainland bluffs and wide cliff ledges near the water. Resident throughout the year near nesting areas, birds range more widely during non-breeding periods. Double-crested cormorants are widespread and breeding populations along the Pacific Coast seem to be increasing in number. They can be found along seacoasts, marine islands, coastal bays, swamps, lagoons, rivers, and lakes. Along the coast, they nest on offshore rocks and islands, exposed dunes, abandoned wharf timbers, and power poles. Birds are usually found within a few hours of their roosting or breeding sites. Breeding populations of pelagic cormorants are relatively evenly distributed from Washington to California and in recent years, populations have been increasing in number. Pelagic cormorants occur in outer coastal habitats, bays, and inlets, especially in rock-bottom habitats and often in water less than 100 m and within 1 - 2 km of shore. These birds will often nest with other pelagic cormorants or near other species of seabirds. Nesting occurs on island cliff ledges, crevices, and in sea caves by building nests out of seaweed. Cormorants are classified as diving birds; their strong swimming ability enables them to pursue and capture their prey underwater. Their diet includes small fishes, squid, crabs, marine worms, and amphipods.

Northern fulmar *(Fulmarus glacialis)* ranges along the Pacific Coast from Alaska to Oregon and they are primarily pelagic. The estimated total population of northern fulmars in the North Pacific is between 3 and 3.5 million individuals. This species primarily breeds in Alaska at colonies on sea cliffs and, less frequently, on low, flat rocky islands. Northern fulmars show strong mate and nest site fidelity. Nests are often raided by weasels and gulls. Northern fulmars are surface feeders, they swim or float upon the ocean's surface while feeding on organisms found just below the surface. The diet of this species includes fishes, mollusks, crustaceans, and cephalopods. Northern fulmars have also been observed following fishing vessels, presumably to feed on offal.

Gulls (*Larus* spp.) that occur along the Pacific Coast include the glaucous gull (*Larus hyperboreus*), glaucous-winged gull (*Larus glaucescens*), western gull (*Larus accidentalis*), herring gull (*Larus argentatus*), California gull (*Larus californicus*), Thayer's gull (*Larus thayeri*), ring-billed gull (*Larus delawarensis*), mew gull (*Larus canus*), Heermann's gull (*Larus heermanni*), Bonaparte's gull (*Larus philadelphia*), and Sabine's gull (*Larus sabini*). For most marine-nesting species in the North Pacific, only rough estimates of nesting populations exist and reproductive success has only been investigated for one to two years. However, it is thought that most gull populations along the Pacific Coast are stable and not considered to be at risk. Most gulls along the Pacific Coast occur during the non-breeding season or are non-breeding individuals. Birds can be found at sea, along the coast, on rocky shores or cliffs, bays, estuaries, beaches, and garbage dumps. Only two species of gulls breed along the Pacific Coast. The glaucous-winged gull has breeding colonies in British Columbia and Washington and the western gull has breeding colonies in California (most are located on the Farallon Islands), Oregon, and Washington. Breeding habitat for these gulls includes coastal cliffs, rocks, grassy slopes or offshore rock or sandbar islands. Pacific Coast gulls feed at the ocean's surface and their diet typically includes fishes, mollusks, crustaceans, carrion, and garbage.

Chinook and coho salmon are important species in the West Coast ecosystem. Ocean conditions are critical to their abundance and distribution.

Chinook (King) Salmon (*Oncorhynchus tshawytscha*) range widely throughout the north Pacific Ocean and the Bering Sea, and as far south as the U.S./Mexico border. After leaving the freshwater and estuarine environment, juvenile chinook disperse to marine feeding areas. Some tend to be coastal-oriented, preferring protected waters and waters along the continental shelf. In contrast, others pass quickly through estuaries, are highly migratory, and may migrate great distances into the open ocean. Chinook salmon typically remain at sea for one to six years. They have been found in ocean waters. They are most abundant at depths of 30-70m and often associated with bottom topography. However, during their first several months at sea, juveniles are predominantly found at depths less than 37 m and are distributed in the water column. Juvenile chinook are generally found within 55 km of the U.S. West Coast, with the vast majority of fish found less than 28 km offshore. Concentrations may be found in areas of intense upwelling. The historic southern edge of their marine distribution appears to be near Point Conception, California. Throughout their range, adult chinook salmon enter freshwater during almost any month of the year. For example, chinook enter the Columbia River between March and November and the Sacramento River between December and July. Chinook salmon mature at a wide range of ages, from two to eight years. Most adult females are 65-85 cm in length and males are 50-85 cm, although fish larger than 100cm are not uncommon. Chinook salmon are the most piscivorous of the Pacific salmon. Fish make up the largest part of their diet, but squids, pelagic amphipods, copepods, and euphausiids are also important.

Coho (Silver) Salmon (*Oncorhynchus kisutch*), also called silver salmon, are a commercially and recreationally important species. They are found in small rivers and streams throughout much of the Pacific Rim, from central California to Korea and northern Hokkaido, Japan. Coho salmon spawn in freshwater streams, juveniles rear for at least one year in fresh water and spend about 18 months at sea before reaching maturity as adults. North American populations are widely distributed along the Pacific coast and spawn in tributaries to most major river basins from the San Lorenzo River in Monterey Bay, California, to Point Hope, Alaska. Two primary dispersal patterns have been observed in coho salmon after emigrating from freshwater. Some juveniles spend several weeks in coastal waters before migrating northwards into offshore waters of the Pacific Ocean while others remain in coastal water near their natal stream for at least the first summer before migrating north. The latter dispersal pattern is commonly seen in coho salmon from California, Oregon, and Washington. Coho salmon rarely use areas where sea surface temperature exceeds 15° C and are generally found within the uppermost 10 m of the water column. While juvenile and maturing coho are found in the open north Pacific, the highest concentrations appear to be found in more productive waters of the continental shelf within 60 km of the coast. Adults enter fresh water during October and November in Washington and Oregon and during December and January in California. Marine invertebrates, such as copepods, euphausiids, amphipods, and crab larvae, are the primary food when coho first enter salt water. Fish represent an increasing proportion of the diet as coho grow and mature.

3.3.4 Miscellaneous Species

3.3.4 Miscellaneous Species

Commercial and recreational fisheries for groundfish take various fish, including finfish, shellfish, corals and other invertebrates. There is little information about the amounts or distribution of such bycatch. Although gear size and configuration and fishing operations are not the same as for commercial fisheries, information available from groundfish assessment surveys with bottom trawl gear can give an indication of the potential types of bycatch of benthic animals. In these surveys, a variety of benthos are taken, including sea urchins, starfish, snails, octopuses, various crustaceans and small fishes. At times, coral, sponges, and other animals may be taken or damaged during fishing (and survey) operations, but the distributions of these benthic animals are poorly known on the West Coast. Pot and longline fisheries may also take some of these animals, but little is known about this bycatch.

3.3.5 Biological Associations

3.3.5 Biological Associations

Most bottom-dwelling groundfish are currently managed based on distinction between nearshore, continental shelf, and continental slope species. For example, rockfishes are managed as assemblages of species grouped into nearshore, shelf, and slope categories (PFMC 2002). These categories reflect differences in fisheries catch compositions and are based primarily on depth which, in combination with distance from shore, roughly characterizes ecological zones. In addition, groundfish that live higher in the water column are managed differently than those living on the bottom. Some groundfish, such as Pacific whiting and shortbelly rockfish inhabit midwater along the coast. For many species, the biogeographic zone varies by life history stage; many groundfish produce pelagic larvae, and juveniles of many species are more commonly found in nearshore areas than as adults. These biogeographic zones also have a north south component, with Cape Mendocino representing an important break in the distribution of many groundfish species (particularly rockfish), hence the use of the 40°10' N line of latitude to separate northern and southern management regions. Finally, particular species may exhibit seasonal migrations, producing some annual variation in the characteristics of these different ecological zones. The nearshore, shelf, slope and pelagic environments can be characterized by combinations of the habitats described below, the species associations (and life stages) particular to these environments, and the trophic relationships between these species. Biological associations are dynamic, changing with time of day, season, life history stage, prey availability, mating opportunities, and environmental variables. Within each of the five regional environments, species associations also vary with depth and latitude. Of necessity, characterization of biological associations in the following sections provides only broad generalizations based on the available information. Most of the information also only pertains to adults; references to other life stages are noted as such.

Non-groundfish species, including other finfish, shellfish, marine mammals, marine birds, and sea turtles, also occupy specific biogeographic zones, often similar to those occupied by various groundfish species. For example, pink shrimp and Pacific halibut co-occur with several flatfish species on the northern shelf. Marine mammal communities are pelagic, but some are found primarily in nearshore waters, whereas others are more common over the shelf or slope. Sea turtles occur in midwater and sea birds are found primarily in or near surface waters all along the West Coast.

Information collected to understand biological associations of West Coast groundfish comes primarily from three sources: fishing activities, research surveys, and research studies. All of the means to collect information have limitations for the purpose of characterizing biological associations. Fishing, survey activities and research studies are often quite limited by gear selectivities, and temporal and spatial scales. Consequently, our understanding of biological associations and ecological relationships for West Coast groundfish is very incomplete.

3.3.5.1 Northern Shelf Environment

The boundaries of the northern shelf environment are 40° 10' N. Lat. (Cape Mendocino) on the south and the US/Canada border to the north, and between 20 and 109 fm, up to 5.5 fm off the sea floor.

Emphasis species that commonly occur on the northern shelf include four overfished groundfish species, as well as arrowtooth flounder, English sole, yellowtail rockfish, Pacific halibut and pink shrimp. The overfished groundfish species are lingcod, canary rockfish, yelloweye rockfish, and bocaccio. Associations among these and other species, as well as habitat on the northern shelf, are more fully described below.

Marine mammals, marine birds, and sea turtles may only occasionally occur near the bottom on the northern shelf and are not considered in the northern shelf environment. These species are considered as part of the pelagic environment (Section 3.3.5.4).

Habitat Off the West Coast, the continental shelf generally broadens from south to north. It widens from a few miles at Cape Mendocino to about 50 miles off northern Washington and generally slopes gently westward. Bordering the nearshore zone, the shelf extends seaward to about 100 fm.

The shoreward edge of the shelf off Oregon is usually composed of soft substrates, primarily sand or green mud. This expanse of soft substrate is interrupted by prominent rocky banks, especially at the seaward edge of the shelf. These banks, such as Heceta Bank, Coquille Bank, Daisy Bank and Stonewall Bank, contain unique habitats formed by varied combinations of rock ridges, boulders, cobbles and pebbles. For example, submersible operations at Heceta Bank showed that diagonally stacked ridges are separated by sand, pebble, and cobble-filled depressions. A narrow band of precipitous pinnacles is located on the edge of the bank and large, round boulders are found on the eastward slope, which gradually fades to cobble and finally mud. In comparison, Coquille Bank is comprised largely of siltstone and mudstone and characterized by eroded, flat, slab-like boulders which were mostly covered by a layer of silt. No rocky ridges were observed on the bank (Barss 1994).

Off Washington, broad fans of gravel created by retreating glaciers from the northern Cascade and Olympic mountains, produce structural habitat on the seafloor. Similarly, empty shells from mussels and gastropods, and deposits of other biogenic debris, such as coral skeletons, sponge spicules, urchin tests, and worm tubes, provide some shelter for fish and attachment substrate for invertebrates.

Submarine canyons, such as Astoria Canyon off the Columbia River, are also prominent features of the northern shelf. Canyon habitat is structurally complex and diverse. It is characterized by vertical walls (textured with joints, fractures and overhangs), ledges, talus slopes, and the canyon floor covered with cobble, boulder and mud substrates.

Climatic conditions influence productivity; the duration and strength of winds favorable for upwelling along the West Coast diminish northward. Wind velocities and upwelling are variable but tend to be at a maximum in the spring to early summer in the region between Point Conception (34.5° N) and the Oregon border (42° N). Off Washington upwelling is relatively minor and is largely restricted to the late spring to early fall; winter storms there result in intense downwelling events (Leet, *et al.* 2001).

Bottom water temperatures on the northern shelf make good habitat for sub-arctic and cold-temperate species. Summertime bottom temperatures observed during the 1986-1998 West Coast triennial bottom trawl surveys ranged between about 7° C and 8.5° C (Shaw, *et al.* 2000).

Biological Associations Plant life on the shelf is small and sparse. Light does not usually penetrate below 60 fm, so algae are not found below that depth (Barss1994).

Non-rocky substrates are commonly utilized by pink shrimp, sea pens, and weathervane scallops. In addition, English sole, petrale sole, arrowtooth flounder, Pacific halibut, big skate and longnose skate frequently co-occur on or very near the bottom in these areas. Hagfish also occur over soft substrates. All flatfish species inhabit the non-rocky substrates on the northern shelf (EFH appendix), but their distributions differ by depth and substrate type (e.g., mud versus sand). Although their distributions overlap, adult arrowtooth flounder, rex sole, curlfin sole, Dover sole, rock sole and petrale sole also occupy deeper waters than sand sole and starry flounder (EFH appendix). Sablefish (particularly juveniles), spiny dogfish, ratfish and soupfin shark also cruise over these soft bottom habitats, in search of prey. Some nearshore species, such as blue rockfish, and deeper dwelling species like yellowtail rockfish, Pacific Ocean perch and Pacific whiting move into these areas to feed.

Banks create locally shallow areas in the otherwise deeper water of the shelf and are highly productive. Rocky substrates are often covered with a distinct and diverse suite of invertebrate species including sponges, corals, anemones, crinoids, hydroids, tunicates, bryozoans, tube worms, mussels, and other animals.

These creatures form a structurally complex environment for other animals, such as brittle stars, shrimp, clams, mussels, barnacles, worms, crabs and fishes.

Common fish species in rocky habitats on the northern shelf include yellowtail, canary, sharpchin, greenstriped, pygmy and rosethorn rockfishes, kelp greenling, and lingcod. Many juvenile rockfishes inhabit these areas, and at Heceta Bank, dense schools above the shallower rocky ridges have been observed. These isolated rocky areas may serve as nursery grounds especially in areas where other suitable nursery habitat is unavailable.

Common fish and invertebrates seen in submersible operations at various habitat types on Heceta Bank and Coquille Bank are summarized in the Table 3.3.2 (Barss 1994).

Table 3.3.2. Species observed in submersible operations at Heceta and Coquille Bank.

NEARSHORE-SAND & GREEN MUD	ROCK RIDGE & PINNACLES	BOULDER-COBBLE	MUD
English sole petrale sole rex sole slender sole hagfish ocean shrimp sea pens scallops	juvenile rockfishes yellowtail rockfish widow rockfish basketstars anemones coral sponges crinoids	pygmy rockfish sharpchin rockfish juvenile rockfishes yellowtail rockfish canary rockfish widow rockfish rosethorn rockfish lingcod greenling yelloweye rockfish bocaccio crinoids sponges anemones shrimp sea cucumbers sea stars octopus	Dover sole rex sole slender sole sablefish thornyheads splitnose rockfish ratfish poachers eelpouts hagfish fragile urchins sea cucumbers snails sun stars brittle stars euphausiids box crabs hermit crabs

Species associations vary during the year, generally related to feeding, growth, and reproduction. Many species make seasonal spawning migrations; for example, female lingcod move to shallow water during the winter to lay their eggs in nests. Dover sole and sablefish are common on the continental slope but make seasonal migrations onto the shelf. Juveniles of many groundfish species also move to deeper areas as they grow and take advantage of new prey sizes and species.

As on rocky banks, invertebrates, such as crinoids, sea anemones, and sponges create additional structural habitat and diversity in submarine canyons. Information about species that commonly inhabit canyons on the northern shelf is very limited, although soupfin sharks and sablefish reportedly are associated with canyons, along with other habitats (See EFH appendix).

Emphasis Species Canary, yellowtail, widow and silvergray rockfish, lingcod and sablefish are frequently associated. Although widow rockfish often occur near bottom, they more commonly inhabit midwaters and are considered a component of the pelagic complex (Section 3.3.5.4).

Yelloweye rockfish are generally a solitary, rocky reef fish. Researchers have observed adult yelloweye rockfish associated with bocaccio, cowcod, greeenspotted, and tiger rockfish (Appendix A).

Adult bocaccio have two primary habitat preferences: some are semipelagic, forming loose schools above rocky areas; and some are non-schooling, solitary individuals (EFH appendix). Solitary bocaccio have been found in association with large sea anemones. Bocaccio are often caught with chilipepper rockfish and have been observed schooling with speckled, vermilion, widow and yellowtail rockfish (Appendix A).

English sole, petrale sole, arrowtooth flounder, Pacific halibut, big skate and longnose skate frequently co-occur. Although distributions of English sole and arrowtooth flounder overlap, arrowtooth flounder are much more abundant at deeper depths in the northernmost areas, especially off Cape Flattery, Washington. English sole are most common in the shallower waters all along the shelf. Although fishing and survey reports indicate Pacific halibut frequently occur at Heceta and other banks on the northern shelf, they probably occupy areas of low-relief and soft substrates on these banks.

Pink shrimp are associated with green mud and muddy-sand bottoms and are important prey for many species. Arrowtooth flounder, petrale sole, sablefish, and Pacific whiting are some of the groundfish that prey heavily on pink shrimp. Predation by whiting may affect the abundance of pink shrimp (Appendix A).

The list of common groundfish species inhabiting rocky and non-rocky substrates in the Northern Shelf Environment is presented in Table 3.3.3 below. Other relevant fish and shellfish species to groundfish bycatch on the northern shelf are also included in the list.

Table 3.3.3. Species associations in the **Northern Shelf Environment**. Emphasis species are shown in bold; minor species are not included.

ROCKY SUBSTRATES	NON-ROCKY SUBSTRATES
Lingcod	**Arrowtooth Flounder**
Canary Rockfish	**English Sole**
Yelloweye Rockfish	**Pacific Halibut**
Yellowtail Rockfish	**Ocean Shrimp**
Bocaccio	Sablefish
Chilipepper Rockfish	Dover Sole
Greenstriped Rockfish	Pacific Sanddab
Redstripe Rockfish	Petrale Sole
Rosethorn Rockfish	Rex Sole
Silvergray Rockfish	Sand Sole
Tiger Rockfish	Soupfin Shark
Vermilion Rockfish	Spiny Dogfish
Spiny Dogfish	Big Skate
Ratfish	Dungeness Crab
Spot Prawn	

3.3.5.2 Southern Shelf Environment

The boundaries of the southern shelf environment are 40°10' N. Lat. (Cape Mendocino) on the north and the US/Mexico border to the south, and between 20 and 109 fm, up to 5.5 fm off the sea floor.

Emphasis species that commonly occur on the southern shelf include two overfished species, as well as chilipepper rockfish and ridgeback prawn. The overfished groundfish species are bocaccio and cowcod. Associations among these and other species, as well as habitat on the southern shelf, are more fully described below.

Marine mammals, marine birds, and sea turtles may only occasionally occur near the bottom on the southern shelf and are not considered in the southern shelf environment. These species are considered as part of the pelagic environment (Section 3.3.5.4).

Habitat The continental shelf diminishes southward along the California coast, from its widest (about 50 nm) at Cape

Mendocino to its narrowest, only a few miles wide along the Southern California Bight. The shelf also forms very narrow rings around several islands in the Southern California Bight which rise sharply from the deep sea floor.

The southern shelf is comprised of similar substrate types as the northern shelf, although species assemblages are often different, largely due to the warmer waters south of Cape Mendocino. In addition to banks, reefs, and sandy or muddy bottoms like those described for the north, canyons are a prominent feature of the shelf. Submersible observations at depths from 40 to 150 fm in Soquel Canyon, Monterey Bay revealed a structurally diverse habitat, comprised of vertical walls (with joints, fractures, and overhangs), ledges, talus slopes, and a canyon floor with cobble, boulder and mud substrates. Invertebrates such as crinoids, sea anemones, and sponges create additional structural diversity.

Biological Associations Many of the species that co-occur on rocky and non-rocky substrates on the northern shelf similarly co-occur on the southern shelf, particularly between Cape Mendocino and the Southern California Bight. Redstripe, rosethorn, and silvergray rockfish are minor species associated with rocky substrates on the southern shelf but are considered more important on the northern shelf. In contrast, greenblotched, greenspotted, and Mexican rockfish and California scorpionfish are important species associated with rocky substrates on the southern shelf, but not in the north. Non-rocky substrates are more abundant on the northern shelf and consequently, flatfishes and pink shrimp are typically more important in the north.

Submersible observations of benthic rockfishes in Soquel Canyon revealed six distinct habitat guilds. In general, small species were associated with mud and cobble substrates of low relief and larger species were associated with high-relief habitat (Table 3.3.4). Some of these guilds observed at Soquel Canyon were remarkably similar to observations at several other sites along the Pacific Coast from Central California to Alaska. Sedentary fishes, such as bocaccio, lingcod, cowcod, greenblotched, greenspotted and yelloweye rockfish, were primarily sheltered under ledges, in crevices, and among large sea anemones on an isolated rock outcrop (Yoklavich, *et al.* 2000).

Table 3.3.4. Main habitat guilds observed in Soquel Canyon (from Yoklavich, *et al.* 2000.

Mud	Cobble-Mud Mud-Pebble	Mud-Cobble Mud-Rock	Boulder-Mud	Mud-Boulder Rock-Mud Rock Ridge	Rock- Boulder
Stripetail R Dover sole Agonidae Shortspine Th	Halfbanded R Greenstriped R Greenspotted R Pygmy R	Stripetail R Rosethorn R Agonidae Greenspotted R Greenstriped R	Rosethorn R Greenspotted R Bocaccio	Bocaccio Rosethorn R Greenspotted R	Pygmy R Bocaccio

Emphasis Species Bocaccio occur in a wide variety of habitats: often on or near bottom features but sometimes over muddy bottoms. Adult bocaccio are often caught with chilipepper rockfish and have been observed schooling with speckled, vermilion, widow and yellowtail rockfish. Chilipepper rockfish occur over the lower shelf and upper slope at depths between 41 and 168 fm. They are semi-pelagic and are found on deep rocky reefs as well as sand and mud bottoms. At times, they form large schools. Adult cowcod inhabit the lower shelf and upper slope, primarily at depths between 82 and 164 fm in the Southern California Bight. They are often found on bottoms with high relief such as rocky reefs. A cowcod conservation area encompassing most of their known habitat was established to provide protection to this overfished species. Ridgeback prawns occur only south of Monterey, California, at depths ranging from 24 to 87 fm. They inhabit substrates of sand, shell and green mud. Species associations for common groundfish and other species in the Southern Shelf Environment are listed in Table 3.3.5.

Table 3.3.5. Species associations in the **Southern Shelf Environment**. Emphasis species are shown in bold; minor species are not included.

ROCKY SUBSTRATES	NON-ROCKY SUBSTRATES
Bocaccio **Cowcod** **Chilipepper** Lingcod Canary Rockfish Yelloweye Rockfish California Scorpionfish Greenblotched Rockfish Greenspotted Rockfish Greenstriped Rockfish Mexican Rockfish Tiger Rockfish Vermilion Rockfish Yellowtail Rockfish Spiny Dogfish Ratfish Spot Prawn	**Ridgeback Prawn** Sablefish California Scorpionfish Dover Sole English Sole Pacific Sanddab Petrale Sole Rex Sole Spiny Dogfish Big Skate Pacific Halibut Dungeness Crab

3.3.5.3 Slope Environment

The slope environment is bounded by the US/Canada and US/Mexico borders to the north and south, respectively, and depths greater than 109 fm, up to 11 fm off the sea floor. The slope extends westward onto the deep continental basin (>1000 fm), which covers most of the EEZ.

Emphasis species that commonly occur on the slope include two overfished species, as well as Dover sole, sablefish, shortspine thornyhead, longspine thornyhead, and spot prawn. The overfished groundfish species are darkblotched rockfish and Pacific ocean perch. Associations among these and other species, as well as habitat on the slope, are more fully described below.

Marine mammals, marine birds, and sea turtles may only occasionally occur near the bottom on the slope and are not considered in the slope environment. These species are considered as part of the pelagic environment (Section 3.3.5.4).

Habitat The continental slope forms a narrow, steep strip at the seaward edge of the continental shelf. Except for the Southern California Bight, the slope drops rapidly from approximately 100 fm to 1,000 fm, less than 50 miles from shore. The islands of the Southern California Bight rise sharply from depths of about 1,000 fm. Beyond 1,000 fm, the bottom gradually slopes downward, to depths of 2,000 fm to form the continental basin which comprises most of the EEZ.

Relatively little is known about bottom types and their distributions on the continental slope. Descriptions of bottom type have been generally identified as "hard" or "soft," often based on experiences with bottom gear during fishing operations. An oxygen minimum zone occurs on the deep slope; thornyheads spawn in this zone at about 300-500 fm.

Biological Associations Little is known about biological associations on the deep, steep slope. Most information comes from co-occurrence of species in fisheries catches. Aurora, bank, blackgill, rougheye, sharpchin, shortraker and yellowmouth rockfish are considered important slope groundfish species on hard bottom. Bank, redbanded, rougheye, and splitnose are also important groundfish species on soft bottom. Bronze-spotted, chilipepper, greenblotched, redstripe, rosethorn, and stripetail rockfish occur on the slope, but are not a major component of fisheries catches. Other groundfish including petrale sole, rex sole, finescale codling and Pacific rattail are also considered minor species on the slope. Little is known about other fish and shellfish species on the slope, except spot prawns. Spot prawns typically inhabit rocky or hard bottoms, including reefs, coral or glass-sponge beds and the edges of marine canyons.

Emphasis Species Dover sole, shortspine thornyhead, longspine thornyhead, and sablefish comprise a deepwater assemblage (DTS) managed as a complex under the FMP. These species occur primarily over soft bottom on the slope. Shortspine thornyhead also co-occur with Pacific ocean perch, darkblotched, splitnose, redbanded and rougheye rockfishes.

Pacific ocean perch occur on the upper slope (109-150 fm) during the summer and somewhat deeper (164-246 fm) during the winter. Adults sometimes aggregate up to 16 fm above hard-bottom features and my then disperse and rise into the water column at night. Most adult darkblotched rockfish are associated with hard substrates on the lower shelf and upper slope at depths between 77 and 200 fm. As mentioned above, spot prawns are also associated with hard bottoms.

The list of common groundfish species inhabiting hard and soft substrates in the Slope Environment is given in Table 3.3.6. Other fish and shellfish species relevant to groundfish bycatch are also included.

Table 3.3.6. Species associations in the **Slope Environment**. Emphasis species are shown in bold; minor species are not included.

HARD SUBSTRATES	SOFT SUBSTRATES
Pacific Ocean Perch **Darkblotched Rockfish** **Spot Prawn** Aurora Rockfish Bank Rockfish Blackgill Rockfish Rougheye Rockfish Sharpchin Rockfish Shortraker Rockfish Yellowmouth Rockfish	**Sablefish** **Longspine Thornyhead** **Shortspine Thornyhead** **Dover Sole** Bank Rockfish Redbanded Rockfish Rougheye Rockfish Splitnose Rockfish

3.3.5.4 Pelagic Environment

The pelagic environment includes waters overlying the slope, shelf, and nearshore environments, all along the West Coast EEZ. Emphasis species that commonly occur in the pelagic environment include two overfished species, as well as market squid, mackerels, sharks, Eulachon, and 16 protected species/species groups. The overfished groundfish species are widow rockfish and Pacific whiting. The protected species include Stellar sea lion, California sea lion, harbor seal, harbor porpoise, Dall's porpoise, Pacific white-sided dolphin, short-beaked common dolphin, long-beaked common dolphin, northern elephant seal, black-footed albatross, Laysan albatross, cormorants, northern fulmar, gulls, chinook salmon and coho salmon. California's protected species also include marbled murrelet, Xanthus murrelet, and rhinoceros auklet.

Habitat The California Current System and climate are the most influential factors in determining the diversity and distribution of marine life in the pelagic environment. Currents and climate off the West Coast are briefly described earlier in

Section 3.2. The California current generally moves from north to south along the West Coast, transporting cooler water toward the equator. It flows near the coast north of Point Conception during most of the year, except in winter when southeast winds force it farther offshore, producing the Davidson Current that flows north near the coast. In some years, this counter current is stronger than normal and is forced as far north as British Columbia, Canada. South of Point Conception, in the Southern California Bight, the coast bends sharply to the east. There the California Current breaks away from the coast and flows offshore along the continental edge until it swings back toward the mainland south of San Diego. In the Southern California Bight, the usual surface flow, called the California Countercurrent, moves north along the coast resulting in a counterclockwise gyre that mixes offshore and nearshore surface waters off southern California (Leet, *et al.* 2001).

Temperature is the most commonly correlated climatic variable used to determine associations with biological processes. The colder, northern waters are good habitat for sub-arctic and cold-temperate species, such as Dungeness crab, Pacific salmon, and petrale sole. The warmer, southern waters are suited to warm-temperate and sub-tropical species, such as California halibut and spiny lobster. The offshore environment is often more stable than nearshore and estuarine environments, where the distribution of warm and cold waters can be highly variable. For example, average monthly sea surface temperatures offshore of San Francisco indicate a distinct summer upwelling pattern with cold sea surface temperatures nearshore, as well as large yearly variations. Within this strong upwelling cell, sea surface temperatures can be colder during the summer in cold years than they are during the winter in warm years (Leet, *et al.* 2001). Local physical processes including intense winds, extended periods of calm, infusions of freshwater runoff, and currents also greatly affect the growth, survival and distribution of many marine species. In addition, seasonal-scale influences are so important to many species that their life cycle is often largely adapted to these seasonal cycles.

Biological Associations Many marine species in the pelagic environment are sub-arctic and cold-temperate species, others are warm-temperate or sub-tropical and still others prefer nearshore areas, perhaps living on land at times. In addition, some pelagic species commonly occur all along the West Coast. Consequently, these species are grouped into northern offshore, southern offshore, and/or nearshore categories to approximate species associations.

Few groundfish species are considered pelagic: Pacific whiting, Pacific cod, widow rockfish, shortbelly rockfish, soupfin shark, leopard shark and spiny dogfish. Some marine mammals are residents (e.g., seals, California sea lions) and others are migrants (gray and humpback whales). Groundfish species provide an important prey source for most marine mammals. Seabirds can search large expanses of the ocean for prey and generally take the most abundant and high energy prey available, especially sardines, herring, smelt, anchovies, squid, some crustaceans and juveniles of many larger fish species. Some seabirds feed near the surface, especially on large fish schools, and others may dive for their prey. More detailed information about the life histories and distributions of the numerous seabirds and marine mammals found on the West Coast is provided in Appendix A. Although protected species are wide-ranging, their distributions have been categorized as primarily northern offshore, southern offshore and/or nearshore and included in the species associations listed in Table 3.3.7 for the Pelagic Environment.

Emphasis Species Pacific whiting forms very large aggregations and migrates long distances between feeding grounds off the northern coast and winter spawning grounds off southern California. Pacific whiting and widow rockfish can co-occur; midwater trawl fisheries for Pacific whiting also catch widow rockfish and sometimes small quantities of canary, darkblotched, and yelloweye rockfish, Pacific ocean perch, and lingcod. Widow rockfish sometimes form large schools, sometimes associated with bottom features. At other times, they may be dispersed in mid waters or on the bottom. Adults are often caught with yellowtail rockfish off Washington.

Relevant species of other fish, shellfish, and squid include jack mackerel, Pacific mackerel, market squid, and walleye pollock. Fisheries for these species may take groundfish species, especially some overfished species, vice versa. In addition, the coastal pelagic species provide an important prey source for Pacific whiting and other marine species. At times, fisheries for Pacific whiting have taken chinook and coho salmon as bycatch and pelagic sharks, such as the common thresher shark, may be vulnerable to capture in groundfish fisheries.

The list of common groundfish species inhabiting offshore and nearshore waters in the Pelagic Environment is given in Table 3.3.7. Other fish and shellfish species relevant to groundfish bycatch are also included. All of the protected species of salmon, marine mammals, sea turtles, and sea birds that have been identified as potentially vulnerable as bycatch (takes) in groundfish fisheries off the West Coast are included in this list.

Table 3.3.7. Species associations in the **Pelagic Environment**. Emphasis species are shown in bold; minor species are not included.

NORTHERN OFFSHORE	SOUTHERN OFFSHORE	NEARSHORE
Widow Rockfish	**Widow Rockfish**	**Jack Mackerel**
Pacific Whiting	**Pacific Whiting**	**Pacific Mackerel**
Jack Mackerel	**Market Squid**	**Chinook Salmon**
Walleye Pollock	**Jack Mackerel**	**Coho Salmon**
Thresher Shark	**Pacific Mackerel**	**California Sea Lion**
Chinook Salmon	**Thresher Shark**	**Harbor Seal**
Coho Salmon	**Stellar Sea Lion**	**Dall's Porpoise**
Stellar Sea Lion	**California Sea Lion**	**Harbor Porpoise**
California Sea Lion	**Dall's Porpoise**	**Long-Beaked Common Dolphin**
Dall's Porpoise	**Harbor Porpoise**	**Black-Footed Albatross**
Harbor Porpoise	**Pacific White-Sided Dolphin**	**Brandt's Cormorant**
Pacific White-Sided Dolphin	**Short-Beaked Common Dolphin**	**Double-Crested Cormorant**
Northern Elephant Seal	**Northern Elephant Seal**	**Pelagic Cormorant**
Black-Footed Albatross	**Black-Footed Albatross**	**Glaucous Gull**
Laysan Albatross	**Laysan Albatross**	**Glaucous-Winged Gull**
Northern Fulmar	**California Gull**	**Western Gull**
California Gull	**Bonaparte's Gull**	**Herring Gull**
Bonaparte's Gull	Shortbelly Rockfish	**California Gull**
Shortbelly Rockfish	Soupfin, Blue, and Shortfin Mako Sharks	**Thayer's Gull**
Soupfin and Blue Sharks	Spiny Dogfish	**Ring-Billed Gull**
Spiny Dogfish	Chinook and Coho Salmon	**Mew Gull**
Eulachon	Guadalupe and Northern Fur Seals	**Heerman's Gull**
Northern Fur Seal	Risso's Dolphin	**Bonaparte's Gull**
Risso's Dolphin	Short-Finned Pilot, Gray, Minke,	**Sabine's Gull**
Short-Finned Pilot, Gray,	Humpback, Blue, Fin, Killer, and	Soupfin Shark
Minke, Sperm, Humpback,	Sei Whales	Spiny Dogfish
Fin, and Killer Whales	Loggerhead, Green, Leatherback, and Olive	Pacific Angel Shark
Leatherback Sea Turtle	Ridley Sea Turtles	Pacific Herring
Short-Tailed Albatross	California brown pelican	Eulachon
Arctic, Common, and	Short-Tailed Albatross	Southern Sea Otter, Sea Otter
Black Terns	Arctic, Common, and Black Terns	Risso's Dolphin
Marbled, Xantu's, and	Marbled, Craveri's, Xantu's and	Fin and Killer Whales
Ancient Murrelets	Ancient Murrelets	California Brown Pelican
Fork-Tailed, Leach's, Sooty,	Black, Fork-Tailed, Ashy, Least,	Black, California Least, Caspian,
Short-Tailed, Pink-Footed,	Galapagos, Wilson's and Leach's	Forster's, Gull-Billed,
Flesh-Footed, and Buller's Shearwaters	Storm-Petrels	Royal and Elegant Terns
Pomarine, Parasitic and	Townsend, Black-Vented, Wedge-Tailed,	Marbled Murrelets
Long-Tailed Jaegers	Sooty, Short-Tailed, Pink-Footed, and	Wedge-Tailed Shearwater
Black-Legged Kittiwake	Bugler's	Parasitic Jaeger
Common Murre	Shearwaters	Black-Legged Kittiwake
Pigeon Guillemot	Polarize, Parasitic and Long-Tailed Gaugers	Common Murre
Parakeet, Rhinoceros, and Cassin's Auklets	Black-Legged Kittiwake	Pigeon Guillemot
Horned and Tufted Puffins	Common Murre	Rhinoceros Auklet
South Polar Skua	Pigeon Guillemot	Black Skimmer
	Rhinoceros and Casein's Auklets	
	Horned and Tufted Puffins	
	South Polar Skua	

3.3.5.5 Nearshore Environment

The nearshore environment extends from the high tide line seaward to 20 fm, from the US/Canada border on the north to the US/Mexico border on the south. It also includes estuarine habitats along the West Coast.

Emphasis species that commonly occur nearshore include cabezon, Dungeness crab, and California halibut. Associations among these and other species, as well as habitat in the nearshore environment, are more fully described below.

Many protected species occur in the nearshore environment, but most are highly mobile and are frequently found in offshore areas, as well. To capture their wide distribution, they are considered as part of the pelagic environment (Section 3.3.5.4).

Habitat The nearshore environment is comprised of a variety of habitats ranging from high-relief rocky reefs to broad expanses of sand and mud. The diversity of physical habitat in the nearshore environment is similar to that of the continental shelf, but being shallower, sunlight, tides, and waves are also important features. Intertidal and subtidal plant communities are highly productive and provide food and shelter for a wide variety of fish, shellfish, and invertebrates. The dominance and diversity of species varies latitudinally with temperature, as well as levels of solar radiation, wave exposure, rainfall and tidal range.

San Francisco Bay, Willapa Bay, and Grays Harbor are large estuaries and important nursery areas for many species of fish and shellfish. Flows from the Columbia River and Strait of Juan de Fuca influence the variety of marine life and are seasonally affected by the direction of the current system off the West Coast.

Biological Associations Nearshore areas north of Cape Mendocino are often dominated by black rockfish, cabezon, redtail perch, and night and surf smelt. Quillback and china rockfish, kelp greenling, and monkeyface prickleback are common in northern nearshore areas, but rarely seen in southern areas. South of Cape Mendocino, where rocky-reef habitat dominates, kelp beds are home to a variety of nearshore rockfish, abalone and sea urchins. California scorpionfish, black-and-yellow, gopher, grass, kelp, olive and calico rockfishes, and treefish are common in southern nearshore areas, but uncommon in northern areas.

Estuaries provide nursery areas for California halibut, surfperches, Dungeness crab, leopard sharks, starry flounder, and other marine species.

Emphasis Species Cabezon commonly inhabit rocky bottoms and kelp beds, although they may also be found on sandy and mud bottoms. To spawn, they deposit eggs in shallow waters on bedrock or in crevices. Adult black rockfish are semi-pelagic and commonly associated with kelp forests and rocky pinnacles. They frequently form midwater schools, but at other times they may be on the bottom. Adults are often caught with other fish, such as yellowtail and widow rockfish. Lingcod is an overfished groundfish species that is common in nearshore areas, and has been considered as an emphasis species in the Northern Shelf Environment (Section 3.3.5.1).

California halibut and Dungeness crab are abundant on sandy bottoms in the southern and northern nearshore environment, respectively. Both species co-occur with a variety of flatfishes may be taken as bycatch in some fisheries for groundfish. California halibut is commonly associated with white seabass. Dungeness crab, through all its life history stages, is an important prey species for many groundfish.

The list of common groundfish species inhabiting rocky and non-rocky substrates in the Nearshore Environment is presented in Table 3.3.8. Other fish and shellfish species relevant to groundfish bycatch are also included in the list among the emphasis species.

Table 3.3.8. Species association in the **Nearshore Environment**. Emphasis species are shown in bold; minor species are not included.

ROCKY SUBSTRATES	NON-ROCKY SUBSTRATES
Cabezon	**California Halibut**
Black Rockfish	**Dungeness Crab**
Lingcod	California Scorpionfish
Kelp Greenling	Pacific Sanddab
Black-and-Yellow Rockfish	Rock Sole
Blue Rockfish	Sand Sole
Brown Rockfish	Starry Flounder
Calico Rockfish	White Seabass
California Scorpionfish	Spiny Dogfish
China Rockfish	California Skate
Copper Rockfish	Big skate
Gopher Rockfish	Rays
Grass Rockfish	
Kelp Rockfish	
Olive Rockfish	
Quillback Rockfish	
Treefish	
Vermilion Rockfish	

3.4 The Social and Economic Environment

3.4 The Social and Economic Environment

This section describes the human activities that directly relate to or are dependent on the groundfish resources. Table 3.4.1 identifies the most relevant components of the human environment. These components are described, focusing on those aspects (impact variables) that are predicted to change under the various alternatives. One of the most important considerations is the incentives that lead to bycatch and those that lead to bycatch avoidance and using more of what is caught The most relevant human components of the affected environment include groundfish harvesters, seafood processors, fishing communities, seafood consumers, and the general public. Bycatch and bycatch mitigation measures (rules made to avoid and reduce bycatch) affect each of these components.

Table 3.4.1. Socioeconomic Components of the Human Environment and Impact Assessment Variables.

Component of the Human Environment	Impact Assessment Variables
Incentives and disincentives regarding bycatch	The benefits and costs to fishers of avoiding and/or discarding fish
Commercial harvesters	Production levels of different sectors; ex-vessel revenues and operation expenses (average costs); distributional effects among commercial harvesters such as changes in level of dependence and involvement; effects on other fisheries.
Recreational fisheries	Value of the recreational experience
Tribal fisheries	Fulfillment of subsistence needs; revenues and costs
Buyers and processors	Gross product revenues and operation expenses (average costs)
Communities	Employment and income
Consumers of groundfish products and other members of the general public	Product prices, quality and availability; non-consumptive and non-use values
Fishing vessel safety	At-sea fatalities and injuries
Management and enforcement costs	At-sea and dockside monitoring and enforcement costs; practicability and administration costs

In addition, bycatch mitigation measures affect fishing vessel safety and pubic costs to administer and enforce the fishery management program.

Information sources to characterize the groundfish industry and fishery included Leet *et al.* (2001), Nordeen (in prep.) and several recent PFMC documents including the FEIS for the 2003 Annual Optimum Yield Specifications and Management

Measures, Groundfish FMP Amendment 17 for Multi-Year Management (PFMCa), and the Environmental Assessment for a Vessel Monitoring System of Groundfish Fisheries (PFMCb).

The Pacific Coast groundfish fishery is a year-round, multi-species fishery that takes place off the coasts of Washington, Oregon, and California. Pacific Coast groundfish support or contribute to a wide range of commercial, recreational, and tribal fisheries. In addition, seafood buyers and processors depend on groundfish harvests. Fishing communities are made up of fishers, processors, and supporting infrastructure such as gear suppliers, grocery suppliers, other enterprises, housing and other typical community services.

Non-tribal commercial fisheries include those that target groundfish, which for the most part are regulated under a license limitation program ("limited entry") implemented in 1994, and fisheries that target other species. From November 2000 through October 2001, 4,579 vessels participated in West Coast commercial fisheries. Of these, 1,341 vessels (37% of the fleet) landed some groundfish. At the beginning of 2003, there were about 500 vessels with Pacific coast groundfish limited entry permits, of which approximately 55% are trawl vessels, 40% are longline vessels, and 5% are pot/trap vessels. (In December of 2003, 92 trawl permits were eliminated through a government/industry buyback program.) Vessels without limited entry permits are categorized as open access because no federal groundfish permit is required for their activities, although some target groundfish species at least part of the time. Gears used by participants in open access commercial fisheries include longline, vertical hook-and-line, troll, pot, setnet, trammel net, shrimp and prawn trawl, California halibut trawl, and sea cucumber trawl gears.

The groundfish limited entry program applies to bottom and midwater trawl, longline, and trap (or pot) gears. Each limited entry permit is endorsed for a particular gear type and that gear endorsement cannot be changed, so the distribution of permits among gear types has been fairly stable. Each permit also has a vessel length endorsement. The total number of permits has typically changed only when multiple permits have been combined to create a new permit with a longer length endorsement. However, in December 2003 a buy-back program permanently retired 92 trawl permits, roughly 35% of the total. Limited entry permits can be sold and leased out by their owners, so the distribution of permits among the three states often shifts. At the beginning of 2003, roughly 39% of the limited entry permits were assigned to vessels making landings in California, 37% to vessels making landings in Oregon, and 23% to vessels making landings in Washington.

The Council allocates harvest specifications (OYs) between the limited entry and open access categories. Most of the Pacific coast commercial groundfish harvest is taken by the limited entry fleet.

Commercial harvest rates of groundfish are constrained by annual harvest guidelines, two-month or one-month cumulative period landing limits, individual trip limits, size limits, species-to-species ratio restrictions, and other measures. This program is designed to control effort so that the allowable catch is taken at a slow enough rate to stretch the season over the full year. Cumulative period catch limits are set by comparing current and previous landings rates with the year's total available catch and predicted participation.

Participants in marine recreational fisheries fish from private and Commercial Passenger Fishing Vessels (CPFV)/charter vessels, as well as from shore. CPFV/charter vessels are vessels for hire that are typically larger and can fish farther offshore than most vessels in the private recreational fleet. Both nearshore and shelf opportunities are important for West Coast recreational groundfish fisheries.

Members of the Makah, Quileute, Hoh, and Quinault tribes participate in commercial, ceremonial and subsistence fisheries for groundfish off the Washington coast. Participants in the tribal commercial fishery use similar gear to non-tribal commercial fishers who operate off Washington, and groundfish caught in the tribal commercial fishery is typically sold through the same markets as non-tribal commercial groundfish catch.

3.4.1 Incentives and Disincentives Regarding Bycatch

Bycatch occurs when a fisher fishes for any particular species and catches something else. Under the MSA, nearly every marine species is classified as a fish, and any fish that is not kept is classified as bycatch. The MSA sets the highest priority as avoiding catching anything that would not be kept, especially if it would die as a result of being captured. There is also a clear priority to prevent injury and death as much as possible. Finally, if something is caught and is dead or will inevitably die, it should be used if practicable. In the groundfish fishery, trip limits are intended and used to keep harvest rates low enough through the season so the limits are not reached too early. This would be effective if fishers could always catch the right fish in the right amounts, but that is impossible in a fishery of more than 80 species, plus all the other marine creatures. The only way to avoid catching something is to not fish, or at least not fish where that species is present. The more one fishes where the fish live, the more will be caught (if he is using a type of gear that catches that species). Fishing where the fish are more abundant also increases the catch. The amount of fishing is called effort. The measure of how well the gear catches a particular species is called the selectivity or catching efficiency. These can be combined into a simple equation that describes how these are related:

catch = effort x selectivity x abundance

It is more appropriate to say catch is proportional to effort, selectivity and abundance, but the general relationships are the same. In simple terms this equation says you will catch more fish if you fish harder (increase effort), use more efficient gear (increase selectivity), and/or the fish are more abundant. To reduce catch (or bycatch), reduce effort, reduce selectivity, or fish where they are less abundant. All bycatch mitigation tools work on one of these components. At the same time, it is important to keep in mind the following facts:

- no fish species exists in isolation (they appear in assemblages or mixed groups)
- geographic distributions of any two or more species do not match exactly
- where two or more species occur in the same location or habitat, their abundances will be different
- a gear type is unlikely to be equally selective for all species; it will catch (or avoid) some better than others

Taking these and other relevant factors into account, the question each fisher faces is how to catch the “right ones” (the ones he wants) without catching the “wrong ones” (the ones he does not want). A slightly different angle to this question may be how to catch fewer of the “wrong ones.” Another consideration is how to turn the wrong ones into good ones, that is, how to improve the value and use of those that cannot be avoided. A major bycatch management challenge is how to set the incentives and disincentives to get the best results at the least cost to the fishers.

Under the current management regime, quota-induced discards can occur when fishers continue to harvest other species when the harvest guideline of a single species is reached and further landings of that species are prohibited. As trip limits become more restrictive and as more species come under trip-limit management, discards increase. In addition, discretionary discards of unmarketable species or sizes are thought to occur widely.

Incentives and disincentives relating to bycatch are discussed in greater detail in Section 4.1.5.

3.4.2 Commercial Harvesters

Commercial fishing vessel owners and captains employ a variety of strategies to fill out a year of fishing. Fishers from the northern ports may fish in waters off of Alaska, as well as in the West Coast groundfish fishery. Others may change their operations throughout the year, targeting salmon, shrimp, crab, or albacore, in addition to various high-value groundfish species.

Although the total amount of groundfish landed in West Coast groundfish fisheries has increased from under 200 million pounds in1987 to a peak in 1996 of over 300 million pounds (Figure 3.17), revenues to the commercial fleet have declined significantly. While landings of Pacific whiting increased during this period, landings of other West Coast groundfish, primarily rockfish and deepwater flatfish species, have declined by nearly 50%. This general decline in groundfish landings other than whiting has been driven by declining stocks of major target species primarily rockfish—several of which have been declared overfished. Part of the decline in landings has been due to reduced harvest of the particular overfished stocks. However, a large part of the overall reduction is due to constraints on harvests of healthier stocks in order to prevent bycatch of overfished stocks.

The decline in landings of non-whiting groundfish has had a significant adverse economic impact on a number of harvesting sectors.

Figure 3.17. Groundfish landings, excluding at-sea whiting, 1987 - 2000. Source: Scholz 2003.

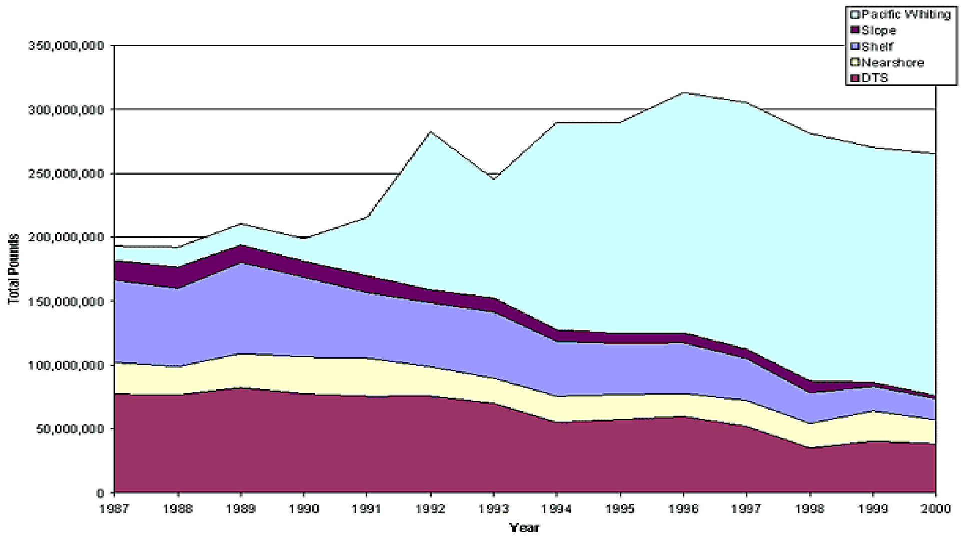


Table 3.4.2 shows exvessel revenues in the West Coast groundfish fisheries (excluding the Pacific whiting fishery) for the years 1999-2002. In general, revenues increased in 2000 by 9% from 1999 levels, then dropped by 16% in 2001 and another 16% in 2002. The declines were greater in the limited entry sector than in the open access sector. Within the limited entry sector, fixed-gear revenues fell by a greater percentage than trawl revenues, primarily due to reduction of the sablefish OY and reduced access to nearshore rockfish.

Table 3.4.2. Exvessel revenues in the groundfish fisheries (excluding the Pacific whiting fishery) by sector, 1999-2002.

	1999	2000	2001	2002
Sector	**Exvessel Revenues ($1,000)**			
Limited Entry Non-Trawl	9,814	10,946	8,693	6,852
Limited Entry Trawl	32,634	34,032	28,257	24,010
Open Access (All)	7,762	8,732	8,254	7,161
Total	**50,210**	**53,710**	**45,205**	**38,023**

Source: Data provided by the Pacific Coast Fisheries Information Network (PacFIN).

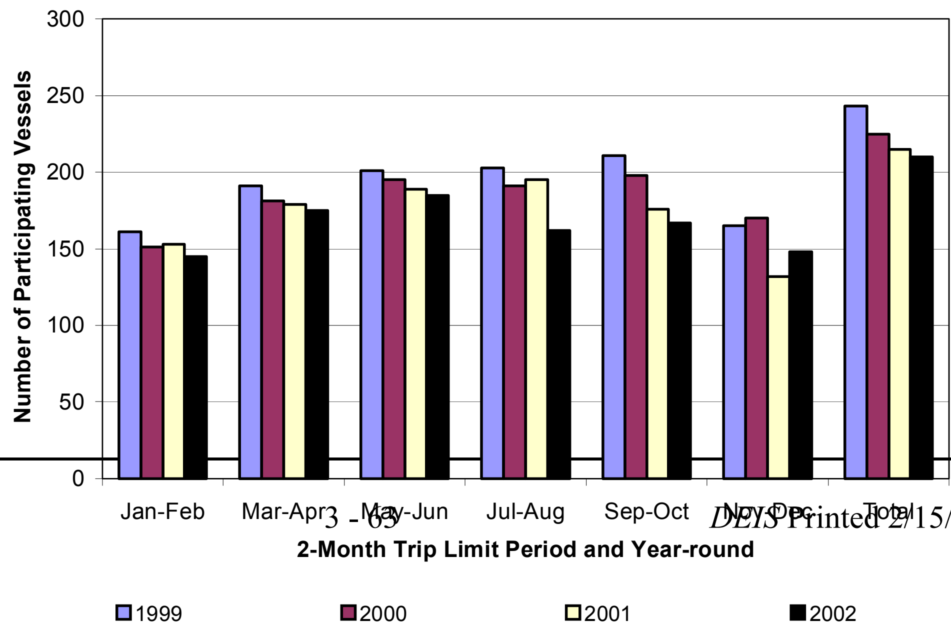
3.4.2.1 Limited Entry Trawl Fisheries

Limited entry trawl fishers target many different of the more than 80 groundfish species, with the largest landings by volume (other than Pacific whiting) of Dover sole, sablefish, thornyheads, widow rockfish, and yellowtail rockfish. Taken as a whole, the 55 rockfish species have made up the largest volume of non-whiting landings in the Pacific coast commercial groundfish fishery. Trawlers take the vast majority of the groundfish harvest by weight and value. In 2001, groundfish trawlers landed 97% of total groundfish harvest by weight (including whiting) but only 75% by value. Trawling is much more dominant north of Cape Mendocino, California (the Vancouver, Columbia, and Eureka management areas) than south of Cape Mendocino (Monterey and Conception areas).

Figure 3.18 shows the seasonal participation pattern of limited entry trawl vessels, except those vessels that participated exclusively in the Pacific whiting fishery. Participation by the non-whiting trawl sector is spread out more evenly over the six 2-month periods in comparison to the participation seen in the fixed gear sector. While there has been a decline in participation by the non-whiting trawl sector during the 4-year period, the decline is relatively small. However, the trawl buyback program approved in late 2003 eliminated 92 trawl permits, so participation will change significantly in 2004.

In addition to these mixed-species fisheries, there is a distinct mid-water trawl fishery that targets Pacific whiting. This fleet includes catcher boats that deliver to shore-based processing plants, vessels that deliver to at-sea processor ships, and catcher-processor vessels. Pacific whiting landings are significantly higher in volume than any other Pacific coast groundfish species. In 1998, whiting accounted for approximately 66% of all Pacific coast commercial groundfish

Figure 3.18. Limited entry trawl vessel participation by period and year, 1999-2002, excluding whiting-only vessels. Source: PacFIN data.



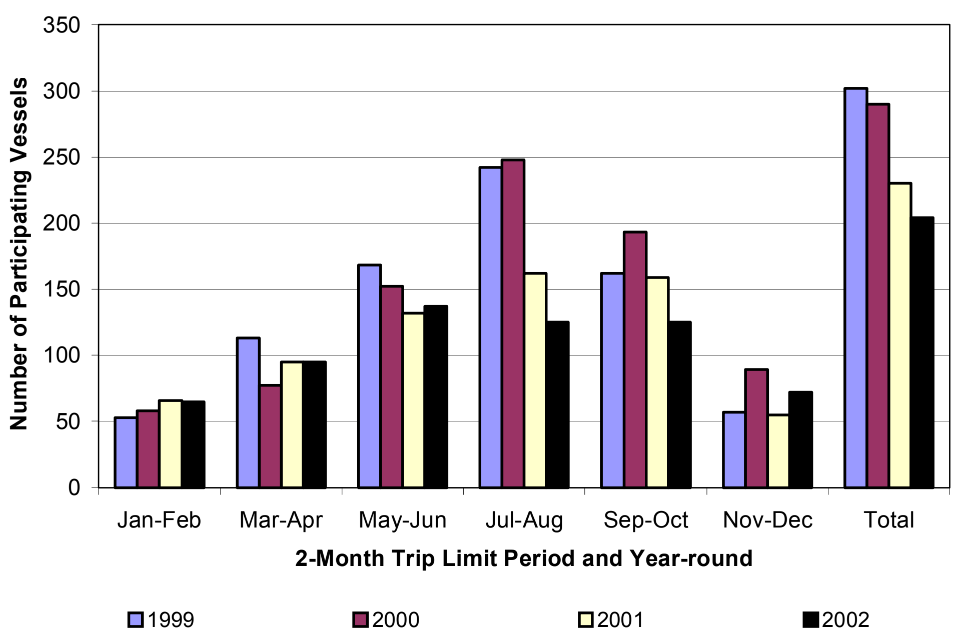
shoreside landings by weight. However, whiting commands a relatively low price and accounts for only about 9% of commercial groundfish shoreside landings by value.

3.4.2.2 Limited Entry Fixed-gear Fisheries

Limited-entry fixed-gear vessels use longline or trap (pot) gear. Sablefish has long been an important target species in this sector; however, some shelf and slope rockfish species have also been important and valuable targets. In recent years, nearshore rockfish and other species have been harvested by the live-fish fishery. Although about 230 fixed-gear permits are issued, only about 180 vessels are active in a given year.

Figure 3.19 shows limited entry fixed-gear vessel participation from 1999 through 2002. During the 4-year period the number of unique limited entry vessels participating in the groundfish fishery declined from 302 in 1999 to 204 in 2002. Declines in participation have been most noticeable during the summer months—in the July-August period the number of participating vessels declined from 242 to 142. The establishment of a sablefish permit endorsement, the “tier” system, and ability fixed gear vessels to stack permits have facilitated a reduction in fleet capacity.

Figure 3.19. Limited entry fixed-gear vessel participation by period and year, 1999-2002. Source: PacFIN data.



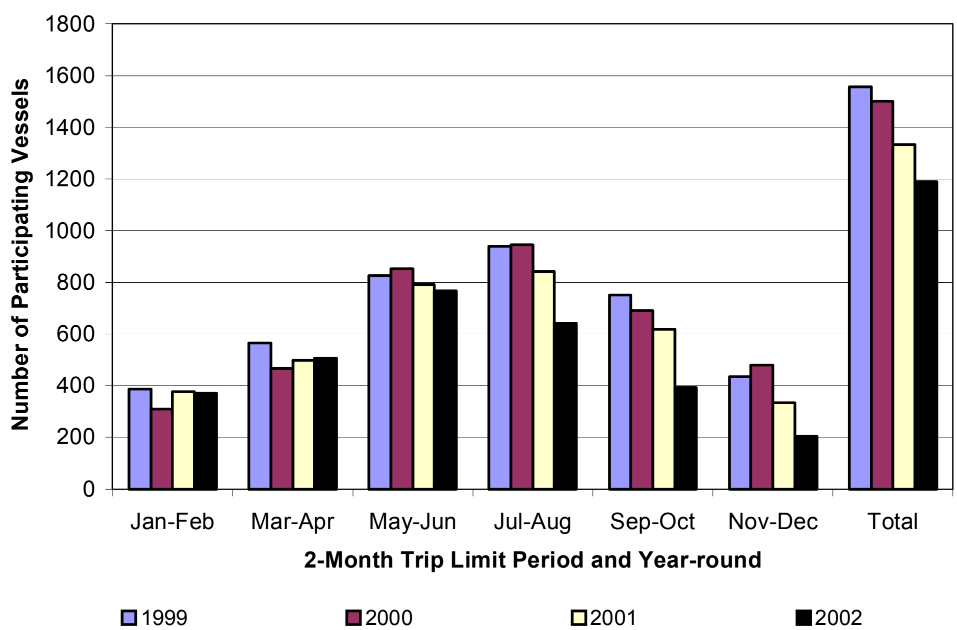
While non-trawl vessels took only 2% of the coastwide groundfish harvest by weight, their harvest accounted for about 25% of the exvessel value due to the prevalence of relatively high value sablefish and live fish landed in this fishery. When whiting is excluded from the totals, non-trawl landings are 10% to 12% by weight and 25% to 27% by value (percent of coastwide total groundfish excluding whiting).

Open Access – Directed Groundfish Fishery

3.4.2.3 Open Access – Directed Groundfish Fishery

Several thousand vessels without limited entry permits have made commercial groundfish landings since the limited entry program went into effect in 1994. Many open access fishers have traditionally targeted groundfish, while others catch groundfish incidentally in other target fisheries. Most open access vessels targeting groundfish use hook-and-line gear for sablefish, rockfish, and lingcod. Others use pot gear, primarily for sablefish and some rockfish species. In southern and central California, some vessels have used setnet gear to target rockfish, including chilipepper, widow rockfish, bocaccio, yellowtail rockfish, olive rockfish and, to a lesser extent, vermilion rockfish. Setnet gear is rarely used now due to area and species restrictions and the greater value of live fish. (Fish caught with setnets usually are dead before the nets are retrieved.) From 1999 through 2002, approximately 1,200 to

Figure 3.20. Open access vessel participation by period and year, 1999-2002. Source: PacFIN data.



1,500 vessels per year made small groundfish landings (Figure 3.20). In 2003 (not shown) the number was substantially less. The seasonal fishing pattern is similar to that seen in the limited entry fixed gear sector, with higher levels of participation during the summer months, but some level of participation throughout the year. In 1999, about 1,000 open access vessels landed their catch in California, about 400 in Oregon, and about 100 in Washington. Since 1999, commercial fishers in California have been required to purchase a nearshore fishery permit to land shallow nearshore rockfish, California scorpionfish, cabezon, greenlings, and California sheephead. This has resulted in a substantial decrease in the number of open access vessels landing these groundfish from 1,100 in 1999 to 202 in 2003.

It is difficult to determine whether an open access vessel targets groundfish or targets other species, because fishing intentions or strategies are not explicitly reported. In this EIS, a given trip or vessel is considered to target groundfish during a fishing trip if it is fishing with any gear other than groundfish trawl and if over 50% of the revenue from landings in that trip were from groundfish species. Other commercial fisheries taking groundfish are described below in the section titled "Other Fisheries That Affect Groundfish (Open Access Non-groundfish Fisheries")

In the directed open access fishery, fishers target groundfish in the "dead" and/or "live" fish fishery using a variety of gears. The terms dead and live fish fisheries refer to how the fish are landed and sold. The dead fish fishery has historically been the most common way to land fish and made up 80% of the directed open access landings by weight coastwide in 2001. More recently, the greater market value for live fish has led to increased landings of live groundfish. Fish are caught using pots, stick gear, and rod-and-reel, and kept aboard the vessel in a seawater tank, to be delivered to fresh markets—such as the large Asian-American communities in California—that pay a premium for live fish. Determining landings from this fishery is difficult because fishing intentions or strategies are not known. In practice, only those sales of species other than sablefish that garner a landed price above $2.50 per pound are classified in the live fish sector. Using this criterion 20% of coastwide directed open access landings by weight in 2001 are considered live fish, compared to only 6% in 1996. This growth in landings may be attributed to the price premium awarded live fish.

Recreational Fisheries

3.4.3 Recreational Fisheries Recreational fishing has been part of the culture and economy of West Coast fishing communities for more than 50 years (PFMC, 2003d). Recreational fishing is conducted from shore, such as beaches, banks, piers, docks, and jetties and from boats, including private, rental, party and charter boats. Groundfish are both targeted and taken incidentally when other species, such as salmon, are targeted. Historically, most recreational fishing along the northern coast targeted salmon and groundfish, especially rockfish, were taken incidentally. Recreational fishing in the open ocean has been on an increasing trend since 1996; however, charter effort has decreased while private effort increased during this period. Coastwide, about twice as many angler trips for groundfish were taken by private anglers (1.33 million) as charter anglers (0.63 million) in 2001. Of these trips, 33,000 private angler trips for groundfish were taken off Washington and Oregon combined, with the remaining 1.3 million trips taken off California. Similarly, a total 59,000 angler trips aboard charter vessels were taken off Washington and Oregon in 2001 and 569,000 private angler trips for groundfish were taken off California. Angler trips for groundfish comprised 43% of all charter trips but only 16% of all private trips. Along the northern coast, recreational fishing traditionally targeted salmon, but rockfish and lingcod often provided a bonus to anglers.

The estimated number of recreational marine anglers in Southern California was two and a half times the number in the next most numerous region, Washington state. While the bulk of recreational fishers in all areas were residents of those areas, a significant share were non-residents. Oregon had the greatest share of non-resident fishers at more than one-fifth of total ocean anglers.

While the contribution of groundfish catches to the overall incentive to engage in a recreational fishing trip is uncertain, it seems likely that the possibility or frequency of groundfish catch on a trip adds to overall enjoyment and perceived value. Some effort shift from salmon to groundfish likely occurred prior to 1996 when salmon seasons were shortened.

Fishing effort, both private and charter, is related to weather, with relatively more effort occurring in the milder months of summer and less in winter. This seasonal trend is more pronounced in higher latitudes, although the reasons include opportunity as well as climate. Salmon seasons are longer in

California than in Oregon, which in turn are longer than in Washington. Groundfish seasons, until recently were also more restrictive in Washington; the lingcod season is closed from November through March.

In 2001, the estimated total catch of all groundfish species coastwide was similar for charter (1,445 mt) and private recreational anglers (1,632 mt). About half of these catches were made up of nearshore rockfish species, followed by lesser amounts of shelf rockfish, other nearshore groundfish and lingcod.

Tribal Fisheries

3.4.4 Tribal Fisheries Four Washington coastal tribes (Makah, Quileute, Hoh, and Quinault) have treaty rights to fish for groundfish (PFMC, 2003d). The primary groundfish species targeted by Tribal fisheries are sablefish and Pacific whiting. Tribal fishers also take small amounts of black rockfish in their *USUAL AND ACCUSTOMED FISHING AREAS*. The Tribes, NMFS, and the Council have negotiated formal allocations for sablefish and Pacific whiting. In addition, the Tribes' anticipated black rockfish catches are taken into account when the Council makes its annual harvest recommendations. There are also several groundfish species taken in Tribal fisheries for which the Tribes have no formal allocation.

In most recent years, Pacific whiting accounted for the bulk of tribal groundfish harvest tonnage (PFMC, 2003d). In 1999 and 2000, 32,500 mt of whiting was set aside for treaty Indian tribes of the U.S. OY of 232,000 mt for 2000. In 2001 and 2002, the whiting OY was reduced to 190,400 mt and 129,600 mt, respectively, and the tribal allocations for those years were also reduced to 27,500 mt and 22,680 mt, respectively. To date, only the Makah tribe has fished on the tribal whiting allocation.

In terms of exvessel revenue, sablefish landings provided well over half of total tribal groundfish revenue each year, except 1998, 1999 and 2002 (PFMC, 2003d). Approximately one-third of the tribal sablefish allocation is taken during an open competition fishery. This portion of the allocation tends to be taken during the same period as the major tribal commercial halibut fisheries in March and April. The remaining two-thirds of the tribal sablefish allocation is split among the tribes according to a mutually agreed-upon allocation scheme.

The bulk of tribal groundfish landings, other than Pacific whiting, occur during the March-April halibut and sablefish fisheries. A small number of tribal fishers use bottom trawl gear. Most continental shelf species taken in the tribal groundfish fisheries are taken during the halibut fisheries, and most slope species are similarly taken during the tribal sablefish fisheries. About one-third of the tribal sablefish allocation is taken during an open competition fishery, in which member vessels from the sablefish tribes all have access to this portion of the overall tribal sablefish allocation. The open competition portion of the allocation tends to be taken during the same period as the major tribal commercial halibut fisheries in March and April. The remaining two-thirds of the tribal sablefish allocation is split between the tribes according to a mutually agreed-upon allocation scheme. Tribe-specific sablefish allocations are managed by the individual tribes, beginning in March and lasting into the autumn, depending on vessel participation management measures used. Participants in the halibut and sablefish fisheries tend to use hook-and-line gear, as required by the IPHC for halibut.

In 2002, tribal sablefish longline fisheries were allocated 10% of the total catch OY (436.7 mt) and then were discounted 3% of that allocation for discard mortality, for a landed catch allocation of 424 mt. For the commercial harvest of black rockfish off Washington State, the treaty tribes have a harvest guideline of 20,000 lb (9,072 kg) north of Cape Alava (48°09'30" N. lat.) and 10,000 lb (4,536 kg) between Destruction Island (47°40'00" N. lat.) and Leadbetter Point (46°38'10" N. lat.).

In addition to these hook-and-line fisheries, the Makah tribe annually harvests a whiting allocation using midwater trawl gear. Since 1996, a portion of the U.S. whiting OY has been allocated to the Pacific Coast treaty tribes. To date, only the Makah tribe has fished on the tribal whiting allocation.

In 1999 and 2000, 32,500 mt of whiting was set aside for treaty Indian tribes on the coast of Washington state, resulting in a commercial OY of 199,500 mt for 2000. In 2001 and 2002, the landed catch OY declined to 190,400 mt and 129,600 mt, respectively, and the tribal allocations for those years were also reduced to 27,500 mt and 22,680 mt, respectively. Makah vessels fit with midwater trawl gear have also been targeting widow rockfish and yellowtail rockfish in recent years.

Twelve western Washington tribes possess and exercise treaty fishing rights to halibut, including the four tribes that possess treaty fishing rights to groundfish. Specific halibut allocations for the treaty Indian tribes began in 1986. The tribes did not harvest their full allocation until 1989, when the tribal fleet had developed to the point that it could harvest the entire Total Allowable Catch (TAC) off Washington, Oregon and California. In 1993, judicial confirmation of treaty halibut rights occurred and treaty entitlement was established at 50% of the harvestable surplus of halibut in the tribes' combined Usual and Accustomed fishing grounds. In 2000, the courts ordered an adjustment to the halibut allocation for 2000-2007, to account for reductions in the tribal halibut allocation from 1989-1993. For 2000 through 2007, the non-tribal fisheries will transfer at least 25,000 lb per year to the tribal halibut fisheries, for a total of 200,000 lb to be transferred to the tribal fisheries over the period. Tribal allocations are divided into a tribal commercial component and the year-round ceremonial and subsistence component.

Tribal commercial halibut fisheries have historically started at the same time as Alaskan and Canadian commercial halibut fisheries, generally in mid-March. The tribal halibut allocation is divided so that approximately 80–85% of their allocation is taken in brief open competition derbies, in which vessels from all halibut tribes compete against each other for landings. In 2002, three of these "unrestricted" openings were held in the spring: a 48-hour opening on March 18, a 24-hour opening on April 2, and a 36-hour opening on April 30. In addition to these unrestricted openings, 15-20% of the tribal halibut allocation is reserved for "restricted" fisheries, in which participating vessels are restricted to a per trip and per day poundage limit for halibut. Two restricted opening opportunities were available in 2002, from March 20 - April 19 and from May 5 - 9. Similar to the unrestricted openings, these restricted openings are available for vessels from all halibut tribes.

3.4.5 Buyers and Processors

Groundfish buyers and processors have been hit hard by declines in groundfish harvest.

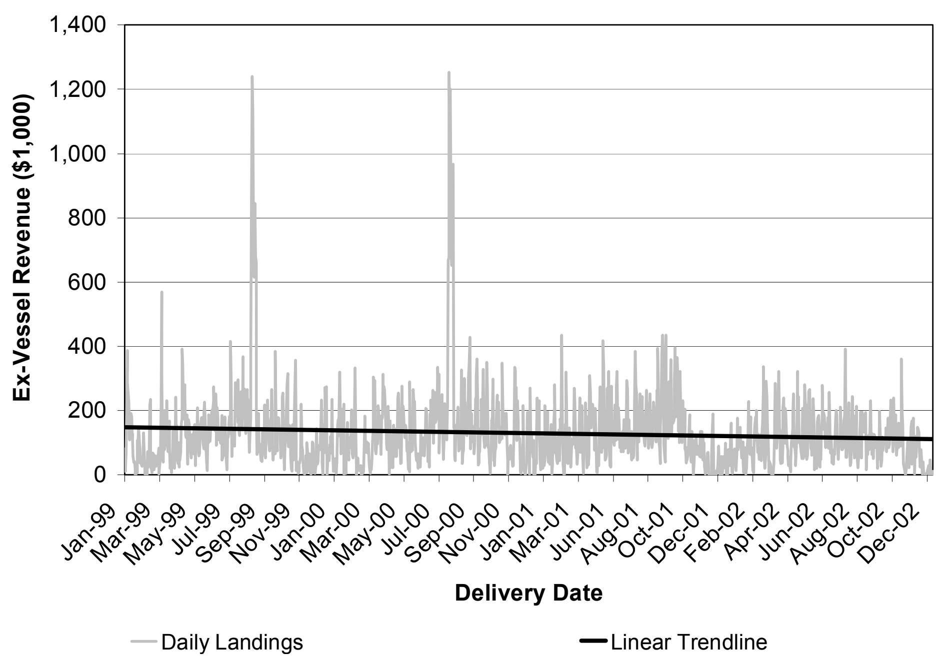
With the exception of the portion of Pacific whiting catch that is processed at sea, all other Pacific coast groundfish catch is processed in shore-based processing plants along the Pacific coast. The majority of the whiting catch is delivered to Oregon processing plants, so total groundfish landings in Oregon are substantially larger than the other states. By weight, 1998 commercial groundfish landings were distributed 13% to

Washington, 69% to Oregon, and 18% to California. In contrast, the exvessel value was Washington, 15%; Oregon, 43%; and California, 41%. The difference is because Oregon processors handle a relatively high proportion of the whiting landings, while California fishers land proportionately more high value species.

One of the primary goals of the West Coast Groundfish FMP is to ensure a steady flow of fish to buyers and processors throughout the year. This section examines flows of non-whiting groundfish to buyers and processors and attempts to determine the impact of 2-month cumulative trip limits.

Figure 3.21. shows ex-vessel value of West Coast groundfish landings (excluding Pacific whiting) from 1999-2002. While the data reflect a general downward trend in revenues, they also show that there is a relatively steady overall flow of groundfish landings. In other words, the management regime appears to be relatively successful in maintaining a steady flow of product to seafood processors. It should be noted that fishery-wide data may mask variation in product flow to individual processors.

Figure 3.21. Value of Daily Landings of Groundfish (Excluding Pacific Whiting), 1999-2002. Source: PacFIN.



However, data also suggest that large buyers of groundfish have been hit hard by decreases in groundfish harvest. There was a 36% decline in buyer counts between 1995 and 2000 for those entities where groundfish was greater than 33% of their purchases and total purchases were greater than $10,000 (OCZMA, 2002). The number of buyers with total purchases greater than $1.5 million decreased by 56%.

The precipitous decline in the number of business entities is due both to reduced deliveries of groundfish and the overall consolidation within the processing industry (OCZMA, 2002). The buyer/processor sector has become quite concentrated, with approximately 5% of the buyers responsible for 80% of purchases (PFMC, 2003b). The largest buyers tend to handle trawl vessels more than smaller buyers. Of the 38 largest buyers of groundfish (those with purchases in excess of $1 million), 73% bought from trawl vessels.

Fishing Communities

3.4.6 Fishing Communities

The groundfish fisheries have historically provided West Coast commercial harvesters and processors with a relatively steady source of income over the year, supplementing the revenues earned from more seasonal fisheries. By maintaining year-round fishing and processing opportunities, the 2-month cumulative trip limits have promoted year round employment in coastal communities. However, the downward trend in revenues caused by lower catch limits and area closures has had a significant negative economic impact on local businesses that are directly or indirectly involved in and are supported by the groundfish fisheries. In particular, the decrease in groundfish catches has had a direct and significant negative impact on individual fishing enterprises. Fishery participants have suffered from a loss of earning potential, investment value and lifestyle. Some fishing operations have been forced to change fisheries or leave the industry. The groundfish crisis has also had a significant effect on the shoreside part of the industry (Chambers, 2002). Included are individuals or firms that process, distribute and sell fishery products and enterprises that provide goods and services to the fish-harvesting sector, such as chandlers, gear manufacturers, boatyards, tackle shops, bait shops and insurance brokers. While the percentage of business derived from the groundfish fisheries may be relatively small for some of these firms, any permanent loss of income during this extended period of stagnation in the U.S. economy could affect their economic viability.

On the other hand, when examined from a community frame of reference, the economic contribution of the harvesting and processing of groundfish fishery resources to the total economy of even small coastal communities is diluted by the relative scale of other economic activities, such as tourism and the wood products industry.

Those who have become unemployed face the social and psychological costs of job loss. Individuals who lose their jobs typically experience heightened feelings of anxiety, depression, emotional distress and hopelessness about the future, increases in somatic symptoms and physical illness, lowered self-esteem and self-confidence, and increased hostility and dissatisfaction with interpersonal relationships. In addition, both spouses and children of such individuals are at risk of similar negative effects. Families may find it difficult to pay bills and afford transportation, health care, and even food and clothing. The results of this financial strain may be high levels of psychological distress among some family members as well as an increase in physical health problems.

In addition to economic losses associated with declines in landings and revenues, there has been the loss of lifestyle to contend with. It is likely that enjoyment of the lifestyle or work itself is an important motivation for fishing among fishery participants. Moreover, some individuals may be motivated to fish for a living by a long-term family tradition. The loss of fishing-related jobs has caused some individuals to abandon the fishing life style. A decrease in the economic viability of the commercial fishing lifestyle has, in turn, diminished the influence of local maritime culture in some communities. The groundfish fisheries are a historically important component of an industry that is deeply intertwined with the social and cultural resources of some coastal communities. For example, the Newport Beach dory fishing fleet, founded in 1891, is a historical landmark designated by the Newport Beach Historical Society.

It is also important to recognize that fishing communities are typically dynamic and continually adapting to change (Gilden, 1999). Despite reductions in groundfish fisheries, other substantial and well managed fisheries remain available to West Coast fishers — Dungeness crab, sardines, Pacific shrimp and albacore tuna (OCZMA, 2002). Many commercial groundfish fishers have already diversified their fishing operations to include these non-groundfish fisheries. Processors, wholesalers, distributors and brokers are obtaining their groundfish from other sources or have looked for substitute products. This period of transition for the communities involved in the groundfish fisheries has been eased by Congressional appropriations for economic adjustment and recovery programs. In 2000, for example, the Federal government appropriated $5 million in social services to the states of California, Oregon and Washington to mitigate the effects of the groundfish crisis. While this level of government assistance is unlikely to continue, coastal communities are expected to continue to find ways to successfully adapt to contracting groundfish fisheries, although many more individual businesses involved in these fisheries will likely face economic hardship and possible bankruptcy.

Consumers of Groundfish Products and Other Members of the General Public

3.4.7 Consumers of Groundfish Products and Other Members of the General Public

Consumers of groundfish products have a number of substitutes for West Coast groundfish products in the regional food distribution (PFMC, 2003d). Most supermarkets and restaurants do not rely on local supplies to stock their shelves or prepare menus (although some retail or restaurant patrons may place a premium on knowing the product they are purchasing is locally caught (Parrish et al., 2001)). Locally caught products are often replaced with close substitutes obtained from elsewhere in the global supply chain. Although rockfish caught in West Coast fisheries are considered to be of high quality and are valued in West Coast fresh markets, similar products from South America, Mexico, Canada or Alaska can substitute for West Coast production.

Marine ecosystems and species associated with them provide a broad range of benefits to the American public (National Research Council 2001). Some of the goods and services these ecosystems produce are not exchanged in normal market transactions but have value nonetheless. For example, in addition to supporting commercial fisheries, these ecosystems support an array of recreational fishing and subsistence activities as well as non-consumptive activities such as wildlife viewing and research and education (Carter 2003; Parrish et al. 2001). Furthermore, some people may not directly interact with the marine environment, but derive satisfaction from knowing that the structure and function of that environment is protected.

Members of the public, in particular representatives of various environmental organizations, have advised the Council and NMFS to endorse the of the National Research Council 2001 report and the 2003 PEW Oceans Committee report regarding MPAs to protect large numbers of species, their interrelationships, and maintenance of natural processes. They believe these positive effects on marine ecosystems and associated species would lead to a significant increase in the levels of the range of benefits these ecosystems and species provide. However, MPA-related changes in these benefits have not been estimated. It is also important to note that some individuals may hold religious or philosophical convictions that humankind has an ethical obligation to preserve species and ecosystems, notwithstanding any utilitarian benefits. Parrish et al. (2001) note that a 1999 survey conducted by the Mellman Group for SeaWeb found a high level of approval for the establishment of MPAs. Seventy-five percent of the individuals surveyed favored having certain areas of the ocean as protected areas; 60% believed that there should be more marine sanctuaries; and 3% believed there were already too many marine sanctuaries. Survey respondents cited the following as "convincing" reasons for creating MPAs: 1) distinctive areas should be protected similar to what is done for national parks (65%); 2) less than 1% of U.S. waters are in MPAs (63%); 3) MPAs would be an important step in improving the health of oceans (58%); 4) harmful activity should be restricted in order to preserve ocean beauty for future generations (57%). Support for MPAs diminished by only 1% when respondents were first read a statement outlining potential negative socioeconomic effects of creating MPAs and increased by 6% when respondents were first read a statement outlining potential positive effects of creating MPAs.

Additional surveys and polls are needed to better understand the values and motives underlying public support of measures that protect marine species and ecosystems, as well as the extent of public support.

Fishing Vessel Safety

3.4.8 Fishing Vessel Safety

Low earnings on the part of individual harvesters limit funds for maintenance and safety equipment. Poor maintenance, bad weather and a desperate need to fish may to lead to significant incidence of injury and losses in life and capital (Young, 2001). In addition, as revenues in the fishing industry decline, vessel owners and captains report it has become more difficult to find, hire, and keep qualified crew. While there are many skilled and capable crew members working on West Coast commercial fishing boats, many who once would have been attracted to the industry are discouraged by increasing regulations and by the apparent lack of a promising future. Conversely, the industry attracts people who are unable to find work elsewhere, and who lack the requisite skills and training. Some are itinerant, and do not stay long enough to be fully trained or invested in vessel operations—including safety (Gilden and Conway, 2000). To the extent that the groundfish crisis will deepen in the future, these negative effects on fishing vessel safety are likely to continue.

Management and Enforcement Costs

3.4.9 Management and Enforcement

[This section includes information on the observer program from the NMFS Northwest Fishery Science Center (NWFSC) website and the 2003 NMFS Bycatch Plan.]

The current groundfish management program relies heavily on trip limits to control fishing effort, with a major goal to maintain a steady rate of commercial groundfish production over the year. Usage of the term "trip limit" has evolved over the past 20 years; initially it referred to the amount of fish a commercial vessel was allowed to catch and retain on a single fishing trip. Over time, this was modified to include trip frequency limits and ultimately the amount of groundfish that may be caught and retained during a specified period of time, typically one or two months. A critical feature of trip limits is that they do not directly limit the amount of catch, but rather only the amount groundfish that may be retained and delivered for sale. Commercial vessels are allowed (and expected) to discard unusable fish and any fish in excess of a specified limit. This approach creates what is referred to as "perverse incentives," which means the effects are likely to be contrary to what is desired. Specifically, trip limits are intended to slow the rate of groundfish harvest so the fishery may remain open all year. However, in reality, it is only the rate of retention that is directly controlled, and the actual catch is only indirectly controlled. Some amount of discarding (called *REGULATORY BYCATCH*) is required each time a vessel reaches a retention limit. Under trip limits, a vessel is not restricted from continuing to fish, but only restricting from retaining any more of the particular species. Also, only the amounts retained and delivered must be reported and recorded under the no action alternative; commercial vessels are not required to report any discarded fish.

This trip limit program was more successful when stocks were near pristine levels and trip limits were fairly liberal; relatively few vessels bumped up against the limits. However, as trip limits were reduced in response to declining stock size and/or premature OY attainment, the rate of discard of many species became critical. Lack of accurate records of total catch (that is, retained plus discarded) can jeopardize efforts to rebuild overfished groundfish stocks and can lead to unintentional overfishing. In addition, there are few records of incidental take (bycatch) of non-groundfish species.

Federal funds have not been available to monitor bycatch in the West Coast groundfish fishery until recently, and NMFS has relied primarily on state monitoring programs that have not adequately recorded total catches. To avoid a costly and controversial on-board observer program, in the face of excessive competition and depleted stocks, NMFS and the Council have developed an increasing complex management approach, usually without the means to monitor its effects and effectiveness. As regulations have become more complicated and restrictive, compliance has dropped along with public respect for the management program. Beginning in 2002, large areas, corresponding to general locations of overfished groundfish species, have been closed to reduce the likelihood those species might be caught accidentally. To the degree the closures correspond to where the overfished fish are, this approach can effectively prevent bycatch of those species. However, traditional enforcement methods are inadequate for such extensive boundaries. Also, the shape of a closed area influences both monitoring complexity and ease of compliance.

Onboard fishery observers collect information on fishing activities and help provide accurate accounts of total catch, bycatch, and discard associated with different fisheries and fish stocks. The West Coast Groundfish Observer Program includes the NWFSC Observer Team and collaborators from the Pacific States Marine Fisheries Commission that direct the program, train new observers, and manage and analyze the bycatch data. The NWFSC's two programs deploy observers on vessels in three of the nine West Coast commercial fisheries (at-sea whiting, groundfish bottom trawl, non-trawl gear groundfish). As part of this program, fisheries observers are placed on commercial fishing vessels to monitor and record catch data, including species composition of retained and discarded catch. Observers also collect critical biological data such as fish length, sex, and weight. The data collected are used in combination with state-collected logbook and fish ticket information to estimate the bycatch in the these West Coast fisheries.

Observers collect information on total catch, species composition of the catch (including any protected resources and seabirds), age structure data from several species and the fishery's interactions with species of concern. This fishery is a major source of salmon bycatch on the coast. Under the Biological Opinion on the effects of the groundfish fisheries on endangered and threatened salmon stocks, the at-sea whiting fishery is anticipated to take up to 11,000 chinook salmon per season as bycatch. With close to 100% of the hauls in the fishery sampled, the program closely monitors the number of chinook taken. The majority of the annual cost of the deploying the observers is paid for by industry. The cost of training, in-season support and debriefing observers is supported by NMFS. Currently the annual cost of the program is approximately $535K ($500K paid for by industry).

The West Coast Groundfish Observer Program (Appendix A for the first annual report) began deploying observers on groundfish vessels in August 2001. The focus of this program is to collect total catch and discard data (including protected resources and seabirds) from commercial groundfish trawl and non-trawl gear (longline, pot, etc.) vessels. Observers in this program collect species composition of the discard and data on target fisheries interactions with species of concern. The observer program's data is already being used in the "bycatch" model that guides West Coast groundfish fisheries management.
This observer program initially targeted the trawl and non-trawl limited entry fleets for observer coverage. The program currently deploys about 40 observers coast wide on the limited entry trawl and fixed-gear groundfish fleet, as well as on some open-access vessels operating off California. Next, the program may expand to also cover open access vessels operating off Oregon in 2004, pending revisions to state regulations. Few vessels land open access groundfish into Washington ports and this fleet and has been covered on a limited basis.

Overall costs of this program, averaged over the number of days observers spend onboard West Coast groundfish fishing vessels, results in a daily cost of about $900. This includes equipment, transportation, some training and data analysis, and other costs. The cost of observer coverage excluding support and data analysis is about $300 per day. Currently (2003), every at-sea processing vessel carries at least 2 observers at the vessel's expense. Vessels operating under exempted fishing permits (EFPs) also pay the expenses of observers required under the terms of the permits, as these observers are generally in addition to those provided by NMFS.

The Observer Program stresses that observers are intended for scientific data collection only, and do not have any enforcement role. The information they collect is essential for a clear understanding of the amount and distribution of bycatch of all species.

Technological developments are expected to mitigate the rate at which the management costs for the groundfish fisheries will escalate. Beginning January 1, 2004, a Vessel Monitoring System (VMS) begins for the limited entry sector of the groundfish fishery. In other regions, VMS has proven to be an effective, cost-saving technology for the monitoring and enforcement of large restricted areas over great distances. A VMS is an automated, real-time, satellite-based tracking system operated by NOAA Fisheries and the U.S. Coast Guard that obtains accurate geographic position reports from vessels at sea. The cost of VMS transmitting units has decreased as new technologies have emerged. At this time, VMS transceiver units range in price from approximately $800 to $5,295 per unit, installed (PFMC, 2003e). The more expensive units allow two-way communications between the vessel and shore such that full or compressed data messages can be transmitted and received by the vessel.

VMS does not replace or eliminate traditional enforcement measures such as aerial surveillance, at sea patrol boats, landing inspections and documentary investigation (PFMC, 2003e). Traditional enforcement measures may need to be activated in response to information received via the VMS. However, VMS positions can be efficient in identifying possible illegal fishing activity and can provide a basis for further investigation by one or more of the traditional enforcement measures. In doing so, it makes certain activities of investigating officers more cost effective because less time will be spent pursuing false trails and fishing operators who are following the rules. Furthermore, VMS positions in themselves can also be used as the basis for an enforcement action.

Another major benefit of VMS is its deterrent effect (PFMC, 2003e). It has been demonstrated that if fishing vessel operators know that they are being monitored and that a credible enforcement action will result from illegal activity, then the likelihood of that illegal activity occurring is significantly diminished. VMS transmitters are required for all limited entry groundfish vessels as of January 1, 2004.

Other Fisheries that Affect Groundfish

3.4.10 Other Fisheries that Affect Groundfish (Open Access Non-groundfish Fisheries)

This section is provided so the reader will have a more complete picture of the West Coast fisheries that affect the groundfish resources and groundfish fisheries. These are other fisheries that may take groundfish as bycatch, but are not managed by the groundfish FMP.

Many fishers catch groundfish incidentally when targeting other species, because of the kind of gear they use and the co-occurrence of target and groundfish species in a given area. To distinguish landings and vessels from fisheries targeting species other than groundfish but take groundfish incidentally from the directed open access fishery for groundfish, the following criterion is used. If revenues from groundfish represent less than half of total revenue for a vessel landing some amount of groundfish, those landings are considered incidental, and the corresponding vessel can be classified in the incidental open access sector.

These incidental open access fisheries may also account for substantive amounts of bycatch, especially for overfished groundfish species. A range of fisheries, identified by the target species, comprise this sector. These include ocean (pink) shrimp, spot prawn, ridgeback prawn, California and Pacific halibut, Dungeness crab, salmon, sea cucumber, coastal pelagic species, highly migratory species, and the gillnet complex. A summary description of these fisheries follows.

California Halibut Fishery

California Halibut The commercial California halibut fishery extends from Bodega Bay in northern California to San Diego in Southern California, and across the international border into Mexico. California halibut, a state-managed species, is targeted with hook-and-line, setnets and trawl gear, all of which intercept groundfish. Trawling for California halibut is permitted in federal waters (3-200 nm from shore) using trawl nets with a minimum mesh size of 4.5 inches. Trawling is prohibited within state waters (0-3 nm) except in the designated "California halibut trawl grounds," which encompass the area between Point Arguello (Santa Barbara County) and Point Mugu (Ventura County) in waters beyond 1 nm from shore. Bottom trawls used in this area must have a minimum mesh size of 7.5 inches and trawling is closed here from March 15 to June 15 to protect spawning adults. Also, California requires a nearshore trawl bycatch permit to land shallow nearshore rockfish, California scorpionfish, California sheephead, cabezon and greenlings. An open access trawler with a bycatch permit has been allowed to land a maximum of 50 pounds per landing of these species in recent years.

Historically, commercial halibut fishers have preferred setnets because of these restrictions. Setnets with 8.5-inch mesh and maximum length of 9,000 feet are the main gear type used in Southern California. Setnets are prohibited in certain designated areas, including a Marine Resources Protection Zone (MRPZ), covering state waters (to 3 nm) south of Point Conception and waters around the Channel Islands to 70 fm, but extending seaward no more than 1 mile. In comparison to trawl and setnet landings, commercial hook-and-line catches are historically insignificant. Over the last decade they have ranged from 11% to 23% of total California halibut landings. Most of those landings were made in the San Francisco Bay area by salmon fishers mooching or trolling slowly over the ocean bottom.

Dungeness Crab Fishery

Dungeness Crab The Dungeness crab fishery is divided between treaty sectors, covering catches by Indian Tribes, and a non-treaty sector. The crab fishery is managed by the states of Washington, Oregon, and California with inter-state coordination through the Pacific States Marine Fisheries Commission. This fishery is managed by season, sex and size of crab. Only male crabs may be retained in the commercial fishery (thus protecting the reproductive potential of the populations), the fishery has open and closed seasons, and a minimum size limit is imposed on commercial landings of male crabs. In Washington, the Dungeness crab fishery is managed under a limited entry system with two tiers of pot limits and a December 1 through September 15 season. In Oregon, 306 vessels made landings in 1999 during a season that generally starts on December 1. In California, distinct fisheries occur in Northern and Central California, with the northern fishery covering a larger area. California implemented a limited entry program in 1995 and as of March 2000, about 600 California residents and 70 non-residents had limited entry permits. Nonetheless, effort has increased with the entry of larger multipurpose vessels from other fisheries. Landings have not declined, but this effort increase has resulted in a "race for fish" with more than 80% of total landings made during the month of December.

California Gillnet Complex Fishery

California Gillnet Complex The gillnet complex is managed by the State of California and comprises two gear types. Fishers use setnets to target California halibut (discussed above), white seabass, white croaker, and sharks. Driftnets are used for California halibut, white croaker, and angel shark. Most of the commercial catch is sold in the fresh fish market, although a small amount is used for live bait. Currently, the only restriction on catches of white croaker off California is a small no-take zone off Palos Verdes peninsula. In the early 1990s, California's set gillnet fishery was subject to increasingly restrictive state regulations addressing high marine bird and mammal bycatch mortality. This forced the fleet into deeper water where shelf rockfish became their primary target. However, as open access rockfish limits became smaller, there was a shift from targeting shelf rockfish with setnets to the use of line gear in the more lucrative nearshore live-fish fishery. Thus, many fishers that were historically setnet fishers have changed their target strategy in response to increasing restrictions and changing market value.

Pink Shrimp Fishery

Pink shrimp The pink (ocean) shrimp fishery is managed with uniform coastwide regulations by the states of Washington, Oregon, and California. The Council has no direct management authority. The season runs from April 1 through October 31. Pink shrimp may be taken for commercial purposes only by trawl nets or pots. Most of the pink shrimp catch is taken with trawl gear with minimum mesh size of 3/8 inch to one inch between knots. In some years the pink shrimp trawl fishery has accounted for a significant share of canary rockfish incidental catch. Since canary rockfish was designated as overfished, all canary rockfish harvests have been greatly restricted. To reduce bycatch of canary rockfish in the shrimp trawl fishery, the states have mandated the use of finfish excluders.

Pacific Halibut Fishery

Pacific Halibut Pacific halibut harvest levels and gear restrictions are set by the International Pacific Halibut Commission (IPHC), with implementing regulations set by Canada and the U.S. in their own waters. A license from the IPHC is required to participate in the commercial Pacific halibut fishery. Commercial halibut fishers use bottom setline gear; any halibut caught in trawls or traps must be released. The commercial sector off the West Coast, IPHC Area 2A, has both a treaty and non-treaty sector. The directed commercial fishery in Area 2A is confined to south of Point Chehalis, Washington, Oregon, and California. In the non-treaty commercial sector, 85% of the harvest is allocated to the directed halibut fishery and 15% to the salmon troll fishery to cover incidental catch. When the Area 2A total allowable catch (TAC) is above 900,000 pounds, halibut may be retained in the limited entry primary sablefish fishery north of Point Chehalis, Washington (46°53'18" N latitude). In 2001, the TAC was above this level for the first time, and 56% (47,946 pounds) of the allocation was harvested. Area 2A licenses, issued for the directed commercial fishery, have decreased from 428 in 1997 to 320 in 2001.

Salmon Troll Fishery

Salmon Troll The ocean commercial salmon fishery, both non-treaty and treaty, is under federal management with a suite of seasons and total allowable harvest. The Council manages fisheries in the EEZ while the states manage fisheries in their waters (within three nm). All ocean commercial salmon fisheries off the West Coast states use troll gear. Chinook and coho are the principal target species with limited pink salmon landings in odd-years. However, commercial coho landings fell precipitously in the early 1990s and remain very low. Reductions in landings are mainly due to diminished opportunity as salmon populations declined. Many natural salmon runs on the West Coast have been listed under the ESA. Ocean fisheries are managed based on zones which reflect the distribution of salmon stocks and are structured to allow and encourage capture of hatchery-produced stocks while depressed natural stocks are avoided. The Columbia River, on the Oregon/Washington border, the Klamath River in Southern Oregon, and the Sacramento River in Central California support the largest runs of returning salmon.

Spot Prawn Fishery

Spot Prawn Spot prawn, which are targeted with both trawl and pot gear, are state-managed. Until late 2003, the prawn trawl fishery was categorized in the groundfish open access (exempted trawl) sector. California had the largest trawl prawn fishery with about 54 vessels operating from Bodega Bay south to the U.S./Mexico border. The State of California has banned the use of trawl gear for this species due to concerns over bycatch of overfished groundfish and other species. Standard gear was a single-rig shrimp trawl with roller gear, varying in size from eight-inch disks to 28-inch tires. Washington state is also phasing out its trawl fishery by converting its trawl permits to pot/trap permits. Washington also prohibits spot prawn trawlers from landing groundfish to discourage incidental catch. In California, area and season closures for the trawl fleet were previously implemented to protect spot prawns in the Southern California Bight during their peak egg-bearing months of November through January. These closures, along with the development of ridgeback prawn, sea cucumber, and other fisheries, and also greater demand for fresh fish, kept spot prawn trawl landings low and facilitated growth of the trap fishery with a live prawn segment. The fleet operates from Monterey Bay - where 6 boats are based - to Southern California, where a 30 to 40 boat fleet results in higher production. In both fishing areas traps are set at depths of 600 feet to 1,000 feet along submarine canyons or along shelf breaks. Between 1985 and 1991 trapping accounted for 75% of statewide landings; trawling accounted for the remaining 25% (Larson and Wilson-Vandenberg 2001). Landings continued to increase through 1998, when they reached a historic high of 780,000 pounds. Growth in participation and a subsequent drop in landings led to the development of a limited entry program. Other recent regulations include closures, trap limits, and an observer program.

California Ridgeback Prawn Fishery

Ridgeback Prawn The ridgeback prawn fishery is managed by the State of California. In 2003, California has also prohibited trawling for this species due to concerns about bycatch of overfished groundfish and other species in this fishery. Ridgeback prawns occur from Monterey, California to Cedros Island, Baja, California, at depths ranging from less than 145 feet to 525 feet. According to Sunada *et al.* (2001) this fishery occurs exclusively in California, centered in the Santa Barbara Channel and off Santa Monica Bay. In 1999, 32 boats participated in the ridgeback prawn fishery. Traditionally, a number of boats fish year-round for both ridgeback and spot prawns, targeting ridgeback prawns during the closed season for spot prawns and vice versa. Most boats typically used single-rig trawl gear.

Prior to the trawl prohibition, the fishery was closed during June through September to protect spawning female and juvenile ridgeback prawns. An incidental take of 50 pounds of prawns or 15% by weight was allowed during the closed period. During the season, a maximum of 1,000 pounds of other finfish could be landed with ridgeback prawns, of which no more than

300 pounds per trip could be groundfish, per federal regulation. Other regulations included a prohibition on trawling within state waters, a minimum fishing depth of 25 fm, a minimum mesh size of 1.5 inches for single-walled codends or 3 inches for double-walled codends and a logbook requirement.

Sea Cucumber Fishery

Sea Cucumber Along the West Coast, sea cucumbers are harvested by diving or trawling. Only the trawl fishery for sea cucumbers, which is also classified as an open access (exempted trawl) fishery, is allowed an incidental catch of groundfish. Sea cucumbers are managed by the states. In Washington, the sea cucumber fishery only occurs inside Puget Sound and the Straight of Juan de Fuca. Most of the harvest is taken by diving, although the tribes can also trawl for sea cucumbers in these waters.

Two species of sea cucumbers are fished in California: the California sea cucumber, also known as the giant red sea cucumber, and the warty sea cucumber. The warty sea cucumber is fished almost exclusively by divers. The California sea cucumber is caught principally by trawling in southern California , but is targeted by divers in northern California. In 1997 the state established separate, limited entry permits for the dive and trawl sectors. Permit rules encourage transfer to the dive sector, which now accounts for 80% of landings. There are currently 113 sea cucumber dive permittees and 36 sea cucumber trawl permittees. Many commercial sea urchin and/or abalone divers also hold sea cucumber permits and began targeting sea cucumbers more heavily beginning in 1997. At up to $20 per pound wholesale for processed sea cucumbers, there is a strong incentive to participate in this fishery.

Coastal Pelagic Fishery

Coastal Pelagic Species (CPS) CPS include northern anchovy, Pacific sardine, Pacific (chub) mackerel, jack mackerel and market squid. They are largely landed with round haul gear (purse seines and lampara nets). Vessels using round haul gear are responsible for 99% of total CPS landings and revenues per year. The southern California round haul fleet is the most important sector of the CPS fishery in terms of landings. This fleet is primarily based in Los Angeles Harbor, along with fewer vessels in the Monterey and Ventura areas. The fishery harvests Pacific bonito and tunas as well as CPS. The fleet consists of about 40 active purse seiners averaging 20 m in length. Although these fisheries are concentrated in California, CPS fishing also occurs in Washington and Oregon. In Washington, the sardine fishery is managed under the

Emerging Commercial Fishery provisions as a trial commercial fishery. The target of the trial fishery is sardines; however, anchovy, mackerel, and squid are also landed. The fishery is limited to vessels using purse seine gear. It is also prohibited inside of three miles and logbooks are required. Eleven of the 45 permits holders participated in the fishery in 2000, landing 4,791 mt of sardines. Three vessels accounted for 88% of the landings. Of these, two fished out of Ilwaco and one out of Westport. In Oregon, the sardine fishery is managed under the Developmental Fishery Program with annually-issued permits, which have ranged from 15 in 1999 and 2000 to 20 in 2001. Landings, almost all by purse seine vessels, have rapidly increased in Oregon: from 776 mt in 1999 to 12,798 mt in 2001. The number of vessels increased from three to 18 during this period.

The Council manages these fisheries under its CPS FMP. Because stock sizes of these species can radically change in response to ocean conditions, the CPS FMP takes a flexible management approach. Pacific mackerel and Pacific sardine are actively managed through annual harvest guidelines based on periodic assessments. In 2003, the Council established an interim management line for allocation of the annual Pacific sardine harvest guideline. The management line splitting the northern and southern components of the fishery occurs now at Point Arena (~39° N latitude). Northern anchovy, jack mackerel, and market squid are monitored through commercial catch data. If appropriate, one third of the harvest guideline is allocated to Washington, Oregon, and northern California (north of 35°40' N latitude) and two-thirds is allocated to southern California (south of 35°40' N latitude). An open access CPS fishery is in place north of 39° N latitude and a limited entry fishery is in place south of 39° N latitude. The Council does not set harvest guidelines for anchovy, jack mackerel, or market squid.

Highly Migratory Species Fisheries

Highly Migratory Species (HMS) HMS include tunas, billfishes, dorado and sharks. Management of HMS is complex due to the multiple management jurisdictions, users, and gear types targeting these species. Adding to this complexity are oceanic regimes that play a major role in determining species availability and which species will be harvested off the U.S. West Coast in a given year. The states currently regulate the harvest of HMS but the Council is in the process of implementing an FMP for fisheries prosecuted in the West Coast EEZ or by vessels originating from West Coast ports fishing beyond the EEZ. There are five distinctive gear types used to harvest HMS commercially, with hook-and-line gear being most common. Other gear types used to target HMS are driftnet, pelagic longline, purse seine, and harpoon. While hook-and-line can be used to take any HMS species, traditionally it has been used to harvest tunas. Drift gillnet for swordfish, tunas and sharks off California and Oregon is most likely to intercept groundfish, including spiny dogfish and yellowtail rockfish.

Albacore is commonly caught with troll gear. The majority of albacore are taken by troll and jig-and-bait gear (92% in 1999), with a small portion of fish landed by gillnet, drift longline, and other gear. These gears vary in the incidence of groundfish interception depending on the area fished, time of year, as well as gear type. Overall, nearly half of the total landings of albacore (millions of pounds coastwide) were landed in California. Other gear includes pelagic longline, used to target swordfish, shark and tunas; and harpoon for swordfish off California and Oregon. Some vessels, especially longliners and purse seiners, fish outside of the U.S. EEZ, but may deliver to West Coast ports.

4.0 Impacts of the Alternatives

4.1 Introduction

In this chapter, the potential impacts of the six alternatives, including no action, are analyzed by evaluating seven types of effects required by NEPA: direct and indirect, cumulative, short and long term, and irreversible and irretrievable effects.

Words printed in *THIS TYPE* are defined in the glossary at the end of this document. Other words are also defined.

Each of the six alternatives would establish a bycatch mitigation program, including mitigation policies and the types of measures that would be used to reduce bycatch and bycatch mortality as much as practicable. Each alternative also would establish the bycatch reporting methodology necessary to support the bycatch mitigation program.

Bycatch mitigation effects fall into four broad categories:

- Avoid catching fish that will not be kept and avoid catching other animals
- Reduce the mortality of fish and other animals that are caught and released
- Reduce the waste of fish that are caught and are dead or will die as a result of being caught
- Avoid unobserved mortality of fish and other animals that directly results from fishing gear.

The highest priority of bycatch mitigation is to reduce unintended or unwanted capture.

In addition, there are social and economic effects. The highest priority of bycatch mitigation is to reduce the capture of any marine plant or animal that is unintended or unwanted. The goal is to harvest desired groundfish with the minimum impact on all other fish and animals. The second priority is to minimize damage to fish and animals that should or would not be caught in a perfectly selective fishery.

To evaluate the effects and effectiveness of various mitigation tools, it is useful to understand some basic relationships and linkages. The amount of catch of any fish or other animal is related to the amount of fishing effort, the selectivity of the gear, and the number of animals present. To reduce catch, any or all of these three factors can be modified.

Catch is proportional to the amount of fishing effort, the selectivity of the gear and methods, and species abundance.

The complicated relationships among these factors become evident when one considers more than one species at a time. No gear is equally selective for two species because of differences, however small, in species shape, size and behavior. Also, species abundance and distribution are never identical. This means that with any amount of fishing effort, the catch of two species will never be the same. The extent of geographic overlap affects the co-occurring catch, as does the degree of similarity in size and shape. While overall averages can be computed, those ratios may not provide the necessary information to develop comprehensive solutions.

> This chapter describes fishing gears, non-fishing regulations, potential effects and mitigation tools. Mitigation tools are ranked, then the tool ranks are applied to the six alternative bycatch management programs. The alternatives are ranked as to how well they achieve the desired results, noting the administrative and user costs associated with each.

We describe the capture methods of the various fishing gears, including selectivity features and placement factors (that is, where and in what conditions can they be used?). We identify non-gear related regulations that can be used, such as harvest specifications, allocation, retention limits, catch/mortality limits, time/area management, and limiting access (reducing fleet size). Collectively, we refer to these management measures as the bycatch "mitigation toolbox." Potential effects of each tool are then described. Next, we rank the effects and effectiveness of each tool, and then apply those ranks to each alternative. In this stepwise process, we provide the basis for modifying any alternative to better achieve the intended goals, taking into account the costs associated with any changes.

We describe in some detail the effects of each tool, focusing on effectiveness, collateral/side effects, etc. We also discuss the economic factors that influence fishing behavior, including costs of capturing unwanted fish and of avoiding their capture.

Recognizing that each alternative is a combination of objectives, emphasis, and mitigation tools, we then describe the combined effects of each alternative. Synergistic and antagonistic effects are identified and described to the extent possible.

Next, we rank the alternatives as to how well they achieve the desired results, noting the administrative and user costs associated with each. The bycatch mitigation programs described in each of the alternatives have differing levels of practicability and/or costliness. Each of the alternatives is rated for its practicability in terms of its effects on management and enforcement costs.

The emphasis, levels of effects, and degree of impacts on biological and fishing communities vary among the different alternatives. One objective of this analysis is to illustrate this tension and evaluate pros and cons, benefits and costs of each alternative. Impacts of alternatives to groundfish, non-groundfish, ecosystem and habitat, and social/economic environment will be evaluated. As this EIS is programmatic in nature, critical comparative methods will be used. Possible analytical methods that might be used to quantify impacts of more specific plans to reduce bycatch, bycatch mortality, and to improve accountability are described. Cost estimates of alternative monitoring programs, where available, are provided.

4.1.1 How this Chapter is Organized

How this chapter is organized

This section generally follows the organization of Chapter 3. For example, the resources described in Section 3.2 are the same as those addressed in Section 4.2 . Section 4.1.2 describes the critical comparative methods used to analyze the effects of the various bycatch mitigation tools and the six alternatives. Section 4.1.3 identifies the available mitigation tools, and Section 4.1.4 describes the effects and effectiveness of the tools. The effects and effectiveness of each tool are ranked, and then ranks applied to each alternative. In this stepwise process, we provide the basis for modifying any alternative to better achieve the intended goals, taking into account the costs associated with any changes.

This chapter outlines the tools available and general impacts of their application. The methods used to evaluate alternatives are described next. Each alternative is presented with corresponding tools used to mitigate for bycatch, bycatch mortality, and to address bycatch accountability. Direct and indirect effects are described in Sections 4.2 through 4.11 Impacts to physical environment are outlined in Section 4.2. Impacts of the six alternatives on the biological environment are described in Section 4.3. Detailed effects of alternatives on groundfish are contained in Appendix B. Section 4.4 provides analysis of impacts on the social and economic environment. Section 4.5 summarizes impacts of each alternative proposed monitoring program. Section 4.6 summarizes impacts to the biological environment. Section 4.7 describes socioeconomic impacts.

4.1.2 Description of Critical Comparative Methods Used: The Ranking System

Fishing has both intended effects (catching desirable fish) and unintended effects. The costs and benefits of these effects can rarely be measured or evaluated precisely, and are often subjective, based on the perspective of the observer. Bycatch and bycatch mortality of living resources are unintentional side effects of fishing; they can be viewed as collateral damage to other living marine resources. These effects can broadly be described as direct effects, indirect effects, and cumulative; short-term and long-term; reversible and irreversible. Some effects equate to irretrievable costs, meaning permanent change that cannot be undone, or would require such a huge investment that attempted retrieval/correction would be futile.

Fisheries data reporting and monitoring are human activities to determine the effects of fishing activities. Some can be accomplished by the fishers themselves; other monitoring is most effectively done by professionals trained in data recording and/or monitoring. Often it is impossible for the fisher or vessel crew to perform both fishing activities and data activities simultaneously; it requires additional manpower. Some data collection and monitoring can be done on shore, some can only be done at-sea. Enforcement programs are also an element of an effective management plan.

The fishery management tools chosen to mitigate intentional and unintentional effects of fishing, such as bycatch and bycatch mortality, are compared for each alternative. In addition, different approaches to fishery monitoring used to estimate total catch and improve accountability are compared.

A numerical ranking scheme is used to help evaluate differences and determine significance of direct, indirect, and cumulative effects. This ranking scheme also contributes to a "practicability" analysis; that is, it will help determine how practicable a particular tool or alternative may be. The ranking scheme uses ranges of scores. A narrow range (a scale of 1 - 2) is used where there is little difference in effects across alternatives and species, or where the distinction is very clear. For example, the effect either occurs or does not occur, and there is no "in between." A broader range (for example, a scale of 1 to 5) is used where the tools (or their application) have a wider range of effects on bycatch, bycatch reduction, and accountability. This is useful where there is a gradation of effects or effectiveness. Anticipated costs are also ranked (high or low). The analysts assigned the ranks based on documented research, previous analyses, personal experience and best professional judgement. In each case these are qualitative judgements, and the ranking are not intended to be viewed as objective measurements or calculations. A lower numerical score (for example, 1) indicates the tool has a greater effect on reducing bycatch, bycatch mortality, or it increases accountability compared to the status quo alternative and possibly other alternatives.

The following example of catch limits uses a scale of 1 - 4. The example is provided to help clarify the ranking system. Differences in ranking between alternatives are due to differences in degree of effectiveness in the application of a tool (See Section 4.1.5).

Catch limits in various forms may be used to reduce bycatch of groundfish species (see Tables 4.3.1 - 4.3.6 in Section 4.3). For Alternatives 1-3, the Council would use a "score card" approach to keep track of 'soft' allocations or divisions of a total catch OY, but reaching a predicted value does not trigger sector closure. Alternative 4 uses individual vessel caps for overfished species and 'hard' sector caps; these do trigger closure either for individual vessels or the entire sector. Alternative 5 uses a combination of individual fishing mortality limits (called RSQs in this document), a 100% retention requirement for overfished species, and IFQs for other groundfish. Individual vessels must stop when they reach a quota. Alternative 6 combines no-take marine reserves, RSQs, IFQs, and a 100% retention requirement for all groundfish.

Soft sector score cards are less effective at controlling bycatch, in part because there is no retention requirement. A catch cap with a retention requirement is a more effective tool for reducing bycatch. This is especially true when combined with a higher level of monitoring, incentives to keep the catch, or means to purchase additional catch share. Ranking of the catch limit tool for each alternative, therefore, is influenced by the specific application of the tool and by other tools that act as catalysts, increasing or decreasing the effectiveness of the tool.

In this example, Alternatives 1, 2 and 3 each receive a score of 4 (lowest effectiveness) because they use soft sector score card catch limits; that approach is less effective at reducing bycatch and bycatch mortality compared to other bycatch mitigation tools. Sector caps in Alternative 4 receive a rank of 2 (moderately effective) for overfished groundfish and 3 (less effective) for other groundfish. For Alternative 5 and 6, the application of catch limits as RSQs and IFQs receive a rank of 1(most effective) at controlling bycatch and bycatch mortality for overfished species. Alternatives 5 and 6 have different ranks for other groundfish because the retention requirements are not the same.

The following steps are used to evaluate the tools and alternatives that employ them:

- **Identify bycatch factors** - Bycatch and bycatch mortality are the products of several factors related to stock status, past and present management strategies, fishing strategies, fish behavior, and other biological characteristics. In combination, these factors make fish more or less vulnerable to bycatch and bycatch mortality. Key factors and characteristics affecting bycatch and bycatch mortality are summarized at the beginning of each species section (Sections 4.3.1, and sections 4.5 to 4.7)
- **Rationalize the mitigation effect** - Each tool has a way (or ways) of reducing bycatch, bycatch mortality, or improving accountability. Where possible, direct and indirect effects for different tools are justified or rationalized. Rationale is based on literature, case studies, and testimony of experts familiar with bycatch issues. The rationale for a tool's effect in reducing bycatch and bycatch morality, and in improving accountability is summarized in Section 4.1.5.
- **Identify direct and indirect effects** by bycatch issue, and species impacted, for the various tools - Different application of a tool may reduce bycatch in different way or to a different degree. Some of the ways particular applications of tools may reduce bycatch are summarized at the end of Section 4.1.5.
- **Rank the effects of tools and alternatives** - Some tool alternatives are explicit in terms of level of effect anticipated. If a tool/alternative can reasonably be expected to have significant impact compared to status quo, it would be ranked higher than status quo. If a tool/alternative has a significant impact compared to status quo and another alternative it would be ranked higher than status quo and the other alternative. Rankings are based on evidence provided in literature, reports, or best professional judgement. Impacts of the various alternatives and tools on groundfish species are summarized in section 4.3.1. Impacts on non-groundfish species are summarized. This EIS describes methods that could be used to quantify measures where possible.
- **Rank the effects of approaches used to improve accountability** - Data reporting, recordkeeping, and monitoring approaches are also evaluated for each alternative. The tools and potential effects on improving accountability are identified in (Section 4.1.5). Each

alternative is then ranked at to its relative effect at improving a particular bycatch accountability issue.
- **Summarize cumulative and indirect effects**.
- **Rank the tools and alternatives** - Mitigation effect, rational, and scores are summarized for tools within each alternative and between alternatives. First, the tools are ranked by alternative as to their relative ability to reduce bycatch, bycatch mortality, and improve accountability (Section 4.1.5). A lower number indicates better performance in reducing bycatch or improving fisher accountability. Ranking includes summary effects of different monitoring approaches used by each alternative. Next, each alternative is ranked for its relative effect at addressing a particular bycatch issue. Relative ease of enforcement and anticipated compliance costs are ranked for each alternative as well.

4.1.3 Practicability

The Magnuson-Stevens Act requires that each FMP reduce bycatch and bycatch mortality "to the extent practicable." In determining whether a particular bycatch mitigation tool is practicable, a number of factors must be considered. In addition to effects on the biological environment (marine species, ecosystem, etc.), the guidelines for National Standard 9 list other factors to consider, including
- changes in fishing, processing, disposal, and marketing costs;
- changes in fishing practices and behavior of fishermen;
- changes in research, administration, and enforcement costs and management effectiveness;
- changes in the economic, social, or cultural value of fishing activities and non-consumptive uses of fishery resources;
- changes in the distribution of benefits and costs; and
- social effects.

The selection of preferred alternative will require the Council to way the pros and cons, and perceived costs and benefits, among the various mitigation tools and combinations of tools. In effect, this is an evaluation of practicability. In the past, the Council has rejected several proposals related to bycatch minimization because they were deemed not to be practicable. A major factor in this determination has been the cost of monitoring, and this will undoubtedly continue to be a major impediment. Bycatch minimization methods that require intensive monitoring are expensive, and funding sources have not been available. Technical feasibility is another factor. For example, extensive gear testing is typically necessary to demonstrate whether a particular gear modification is technically feasible, or to determine how effective the modification would be in accomplishing the desired results. A savings or beneficial impact in one direction could have adverse "side effects," such as increasing bycatch of a different species.

Bycatch Mitigation Tools: The Mitigation Toolbox

Harvest Levels
- ABC/OY
- sector allocations
- trip (landing) limits
- catch limits
- individual quotas

Discard Caps (limits and prohibitions)

Gear Restrictions

Trawl
- mesh size
- footrope diameter/length
- net height
- codend mesh and dimensions
- design: on-bottom or pelagic
- bycatch reduction devices (BRDs)

Line
- number of hooks
- hook size
- line length
- retrieval requirements

Pot/trap
- number of pots
- pot size
- escape panel in net/pot
- retrieval requirements

Other
- setnets (gill and trammel nets)

Time/Area Restrictions
- seasons
- area closures
- depth closures
- marine reserves

Capacity (number of participants)
- permits/licenses/endorsements
- limited entry

Capacity (Vessel Restrictions)
- vessel size
- engine power
- vessel type

Monitoring/Reporting Requirements
- permits/licenses
- registrations
- Fish tickets (commercial landings/ sales receipts)
- Vessel logbooks
- Surveys
- Punch cards/tags (recreational)
- Port sampling/on-shore observers
- On-board observers
- Vessel monitoring systems (VMS)
- Onboard video recording devices
- Enforcement

4.1.4 Bycatch Mitigation Tools

Management measures, referred to here as mitigation "tools," are the rules and requirements to control the fishing activities and to mitigate the effects of fishing on the fishery resources and other components of the natural environment. Management measures are the tools used to achieve the goals and objectives of a management program. In the context of this EIS, they are the means for reporting, monitoring, and reducing bycatch and bycatch mortality. Their purpose is to contribute to achievement of the bycatch management strategy.

Establishing Definitions to Characterize Management Strategies

In analyzing the utility, effects, practicability and effectiveness of various management measures, it is necessary to understand the cause and effect relationships as well as the linkages between tools, toolboxes, objectives, policies and goals. Tools and toolboxes are most easily described by their function, along with a specific vocabulary for function-related characteristics. For example, we can describe a wrench as a tool used to tighten or loosen nuts. Although it could also be used to pound, pry, and dig, it does not do those activities as effectively as other tools would. Similarly, we can describe a hammer as a tool used to pound nails, flatten metal, align parts, and separate attached components. Combined with a chisel, it can be used to shape objects. Incorrect or careless use of a hammer or management tool can result in unintended results; thoughtful or imaginative use can result in several desired effects simultaneously.

Description of Bycatch Mitigation Tools

Description of Bycatch Mitigation Tools

The primary components of a fishery that can be "managed" are gear, vessels, harvest levels, times and areas fished, and capacity (number of vessels and potential effectiveness of those vessels). Other management tools include monitoring/ reporting requirements. Bycatch mitigation tools, or measures, are the means used to manage these components. The following is a description of the different tools.

Harvest Level Specifications: ABCs, OYs and Allocations

Harvest Level Specifications: ABCs, OYs and Allocations. Groundfish harvest specifications are the first level of conservation and management to ensure that harvest stays within sustainable levels. Harvest specifications are typically set annually[1/] and are based on stock assessments whenever possible.[2/] Assessment scientists follow rigorous scientific procedures throughout the stock assessment process, taking into account as many factors as possible to determine the past, present and future condition of the stock. A harvest rate is applied to the best estimate of current stock abundance, taking into account age structure of the population, anticipated reproduction in future years, and other information on stock condition. Different species are capable of sustaining different harvest rates; typically, fast growing species that reproduce rapidly can be harvest at higher rates than slow growing species that reproduce slowly or sporadically. Many rockfish species fall into this second category, while flatfish are more "prolific." Assessment scientists apply the appropriate rate to the biomass estimate to calculate an *ACCEPTABLE BIOLOGICAL CATCH* (ABC). For stocks below 40% of their "unfished" population size (biomass or productivity level), the FMP harvest control rule adjusts the harvest downward to encourage population growth; this harvest level is the *OPTIMUM YIELD* (*OY*) for the stock. In the case of an *OVERFISHED* stock (one that is below 25% of its unfished population estimate), OY is set to rebuild the stock to the 40% level, according to a rebuilding plan. The default formula for calculating OY is described in detail in the FMP and SAFE document, and is commonly referred to as the

[1/] The Council has recently approved (in 2003) an FMP amendment to create two-year harvest specifications.

[2/]The stock assessment process is described in detail in the groundfish FMP and SAFE documents. Comprehensive stock assessments have been prepared for only about 20 species due to data limitations. In some cases, harvest specifications are based on historical harvest levels.

"*40-10" OY* adjustment. OY can apply to total catch of a single species or species group; it can apply throughout the entire region or to smaller management areas. Estimated bycatch (discard) levels are also taken into account so the best estimates of total catch do not exceed the intended levels.

In some cases, the calculated OYs of species in an assemblage are out of proportion with the typical catch ratios in the fishery. This is especially true in assemblages that include overfished stocks. In those cases, harvest rates for abundant stocks may need to be restricted in order to protect the weak stock(s). In such cases, the OY for an abundant stock may be reduced to reflect the expected smaller harvest.

OYs for several stocks are subdivided and allocated among Tribal, recreational and commercial fisheries. The commercial allocation is typically further subdivided between the *LIMITED ENTRY* and *OPEN ACCESS* sectors. In a few cases, most notably sablefish and whiting, a limited entry allocation may be further subdivided.

Trip limits, Bag limits, and Catch Limits

Trip Limits, Bag Limits, and Catch Limits

Trip limits are retention and landing limits (by species or species complex) that apply to individual commercial fishers, vessels, permits, gear groups, or other defined groups in a given area for a given period of time. **Bag limits** are the equivalent for recreational fishers. Any groundfish captured beyond a specified trip or bag limit are classified as bycatch (if discarded) or a violation (if retained). Trip and bag limits, as they have traditionally been applied, do not require fishers to stop fishing when the specified limit has been reached. As long as the fisher/vessel does not retain more fish than the limit, additional fishing is allowed. The intention of trip and bag limits is to remove the incentives to catch more fish. Any fish beyond the limit must be released or discarded, even if it is dead. This creates an incentive to avoid catching the fish, or, conversely, a level of disincentive based largely on the cost of sorting and extra handling, or a feeling of being wasteful. The incentive/ disincentive is not a specified monetary amount, and is not equal in all individuals. On the other hand, failure to release or discard excess groundfish (or other species) is a fishing violation. Each fisher has (potentially) the same monetary incentive to discard, which may be stronger than the incentive to avoid catching.

Trip limits and bag limits refer to the amount of fish that may be kept; they are intended to discourage further fishing, but do not prohibit continued fishing. Any additional fish caught must be released/discarded. All those fish are bycatch.

Over the years, the Council and NMFS have revised the definition and use of trip limits, partly in response to fishermen's concerns about discard and waste of useable fish. Fishers and managers realized that waste would occur and, as a policy decision, the FMP acknowledged a level of discard was inevitable and acceptable. This was reflected in the definition of OY, which originally included only those fish that could be captured and retained under the gear and retention limits adopted each year. The public ethic concerning fisheries waste has changed over the years, as reflected in the 1996 *SUSTAINABLE FISHERIES ACT* mandate to minimize bycatch to the extent practicable.

Initially, trip limits were designated as per-trip limits, and sometimes the number of trips was also restricted (for example, not more than one trip per week might be allowed).

Catch limits or fishing mortality limits are very different from trip limits!

Catch limits, on the other hand, restrict the amount of fish that may be *caught*, whether landed or discarded. Catch limits require fishers to stop fishing when a limit is reached. Catch limits have not been used in the federal groundfish management program but are included in three of the alternatives under consideration in this EIS.

INDIVIDUAL QUOTAS (IQS)**,** sometimes referred to as *INDIVIDUAL FISHING QUOTAS* or IFQS, are a tool that can be set up to be driven by market/economic incentives. IQs can be allocated to an individual, group, corporation, or vessel. IQs can be transferable ("ITQs") or non-transferable. They can be based on a share of the total OY, or a specified amount of fish. They can grant ownership, or grant an opportunity to catch.

IQs can be defined as landing limits or as catch limits. If they are applied as catch limits, fishermen still have the option to discard unwanted fish, but those fish would count against their quota. This would increase the incentive to keep the fish rather than use them as bycatch. It would also mean the quota holder would have to stop fishing immediately upon reaching any quota limit or acquire additional quota share.

It may be useful to distinguish categories of species based on their stock status or other factors. For example, overfished species would likely be more restricted than healthy stocks. A designation such as *RESTRICTED SPECIES QUOTA* ("*RSQ*") might be useful to distinguish overfished groundfish stocks from prohibited species. Catch limits applied to prohibited species are typically called prohibited species catch (PSC) limits or caps.

Discard Caps (limits and prohibitions)

Discard Caps (limits and prohibitions)

Discard caps (sometimes called discard limits in this EIS) have not been used in managing the West Coast groundfish fisheries. However, vessels participating under an Exempted Fishing Permit in the shorebased Pacific whiting fishery are prohibited from sorting and discarding fish at sea. This could be interpreted as a discard cap of zero. As discard caps might be applied more generally, they would place a limit on the amount of any species that could be discarded after it is captured. Two general purposes have been identified for discard limitations. First, under the Magnuson-Stevens Act, fish are only considered bycatch if they are discarded. By limiting (or prohibiting) the amounts that may be discarded, bycatch can be directly reduced or eliminated. Second, discard prohibitions (caps set at zero) can facilitate shore-side observations of bycatch instead of shipboard observations. In order to be effective, some method of verification is necessary.

Few groundfish captured near the seafloor in deep water (for example, water deeper than 100 fathoms (600 feet)) survive the trauma of temperature and pressure change, crushing and abrasion (in trawl nets), and other physical effects. Notable exceptions are sablefish and lingcod, both of which lack an air bladder susceptible to excessive expansion. Pacific halibut is another species that appears to be less vulnerable to these effects, although survival of trawl-caught halibut is only about 50% at best. Bycatch mortality rates of these species would increase if discard caps were established. Rockfish, on the other hand, are particularly susceptible to barotrauma; essentially all rockfish brought from depth to the surface die. Discard caps on these species would not increase mortality rates.

Discarded groundfish, other fish and offal from fishing vessels are scavenged by a variety of marine animals, including seabirds, marine mammals, and various fish and benthic invertebrates. The contribution of discard to these trophic levels has not been assessed quantitatively. Reduction of discarded groundfish and other species would likely have unquantifiable adverse impacts on such species.

Discard caps and prohibitions would require that bycatch be delivered to shore and sold or retained for personal use. For commercial fishers, this would mean delivery and sale to a processing facility. For recreational fishers, it would mean retention until the fisher returns to shore. Commercial fishers would have to find a willing buyer to purchase fish that may not be desirable to established or typical markets. Failing to find a purchaser that would purchase and use these species, a commercial fisher would need to dispose of that bycatch either on shore or at sea.

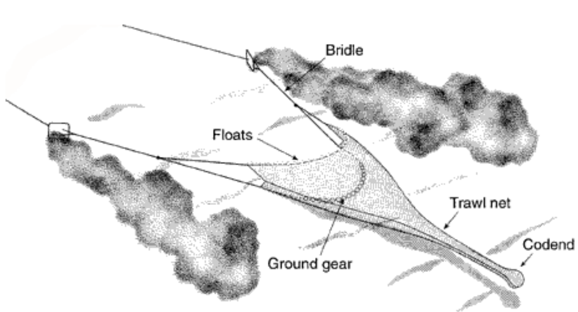
Gear Definitions and Restrictions

Gear Definitions and Restrictions

West Coast groundfish fishermen are allowed to use 4 basic gear types to catch groundfish: *TRAWLS*, *HOOK-AND-LINE*, traps ("*POTS*"), and, in part of California, set nets. (Recreational fishers may also use spears.) These gears capture fish in different ways, and fishermen know how their gear catches fish, what types of fish the gear catches better, and how to best operate the gear to maximum advantage. Every commercial fisherman's intent is to catch fish to make money, and each has an idea of how to make more money at less cost. Catching unwanted species creates costs of sorting the wanted from the unwanted. Fishing in an area with many seafloor hazards can increase costs through damaged or lost gear; refining the gear by adding protective components or "tuning" it can reduce the risks. Gear definitions, requirements and restrictions can be effective in achieving some management objectives, often at the expense of harvest efficiency. Much of the history of fishing and fishery management is the result of fishermen's efforts to improve their catching efficiency and management trying to reduce their efficiency.

Trawl

West Coast commercial fishers use a variety of otter trawl types. This diversity of gear types is a result of the diversity of fisheries (fishing strategies) and bottom types in the region. The specific gear design used is typically a result of the target species complex (whether they are on the seafloor or higher in the water column) and whether the seafloor is smooth or rough, soft or hard.



Otter trawls are not just simple sieves used to collect everything in their path; they are actually very complex systems designed to target specific types of fish in specific conditions. Trawl gear has several components, including the doors (otter boards), bridles, *FOOTROPE* (“ground gear”), and the net body, including the *CODEND*. Trawl doors can be of various sizes and designs to match the target strategy and net. Their purpose is to help sink the net to the desired depth, hold the “mouth” open, and help move fish towards the net. Bridles connect the doors to the net and can be chain, bare wire, or covered wire. The footrope is attached to the bottom front of the net and can include chain-wrapped wire, rubber cookies, rollers, bobbins, and tickler chains.

Bottom trawls are designed to capture fish that are on or near the seafloor, such as *FLATFISH* (flounders). Fish herding is an important aspect of trawl design and depends upon the hydrodynamic forces of the doors and the sediment clouds generated by the ground rigging and footrope. In *BOTTOM TRAWLS*, the footrope is designed to get the fish up off the bottom. The net body can vary based on the head rope height, the amount of overhang, and the mesh sizes of the various net panels. The top of the net typically has floats attached to help hold it open. The doors, ground rigging behind the doors, and the footrope can come into contact with the seafloor. With the exception of the doors, trawl gear must be relatively light on the bottom to maintain its shape and effectiveness. The net itself typically does not drag along the bottom but may sometimes contact the seafloor, especially when there are obstructions. Chafing gear, a protective covering fastened to the underside to prevent abrasion, tearing, and other damage, may be attached to protect the underside of the net from snagging and tearing.

In a “cutback” trawl, the floats are behind the footrope (ground gear) or the top of the net above the footrope is constructed of wide meshes (or open) so that any fish can escape by swimming upward. This type of net is being tested for its ability to avoid rockfish, which typically are slightly off-bottom or swim up when frightened. Flatfish tend not to swim as far upward, and therefore may not escape as readily.

MIDWATER (*PELAGIC*) *NETS* are used to target Pacific whiting. Smaller mesh (3 inch minimum) is used, compared to 4½ inch mesh used for bottom trawls. Prior to about 1987, midwater nets used for whiting were smaller than those typically used since then. Midwater nets use the doors, bridles, and large mesh to herd fish towards the codend, rather than sediment clouds, and typically do not come into contact with the seafloor.

BYCATCH REDUCTION DEVICES (BRDs) are typically not used in West Coast groundfish trawls but are used by groundfish trawlers in Alaska (to reduce bycatch of Pacific halibut) and by West Coast shrimp and prawn trawlers (to reduce groundfish bycatch).

Potential tools to mitigate trawl gear bycatch

Potential tools for mitigating trawl gear bycatch deal with several components of a typical trawl that address selectivity and/or placement: mesh size, type of footrope, net size and shape, chafing gear, type or design (on-bottom or off-bottom/pelagic), and use of bycatch reduction devices.

Mesh size - The size and shape of a net's mesh are related to the size and shape of fish it will capture, and these can be adjusted to select for fish of different sizes and shapes. Larger mesh increases the chances for small fish to escape. Smaller trawl mesh catches more small fish along with the larger fish. Mesh selectivity can never be perfect, but much research over the years has been conducted to improve the catching efficiency and selectivity of trawl gear. For the past several years, regulations have specified 4½ inches as the minimum mesh size in West Coast groundfish bottom trawls and 3 inches minimum in midwater trawls. The minimum mesh size in bottom trawls was increased in the early 1990s from 4 inches to 4½ inches to increase escapement of small fish, especially those below marketable size.

Footrope diameter- The footrope of a bottom trawl is the line (a cable, for example) along the bottom front edge of the net that contacts the ocean floor. The footrope is important in making sure the trawl stays in contact with the seafloor but does not dig into the mud or snag on rocks or other structures. The diameter of the footrope can be increased by attaching rollers or bobbins; larger diameter footropes tend to move over the seafloor more smoothly and easily. Larger diameter footropes allow trawls to be used in areas where the seafloor is rough, such as rock piles. Without the protection of large rollers, trawls cannot be fished effectively in those areas. This relationship between footrope diameter and fishing location has been used since 2000 to reduce trawl fishing in rocky areas where overfished rockfish tend to be concentrated. Based on an industry proposal, the Council and NMFS reduced trip limits for most species for vessels that used footropes over 8 inches in diameter. This would reduce trawl encounters with fish species in rocky ("high relief") areas, especially on the continental shelf.

Trawl size/configuration - Trawls range in size from relatively flat, small, bottom trawls to very wide, tall midwater trawls.

The catching capacity of a trawl is related to the dimensions (width and height) of the net; a small net cannot catch as much as a large net. One way to reduce catching capacity would be to limit net size. This could be accomplished by restricting the maximum length of the footrope, which must match the width of the net.

Potential tools to mitigate trawl gear bycatch

Taller nets cover more of the water column; in bottom trawls, they tend to catch species (such as some rockfish) that hover above the bottom or try to escape upwards. Trials with flatter nets are being conducted to see if rockfish can be avoided; initial results indicate this may be an effective way to reduce the catch of certain rockfish species without reducing flatfish catch.

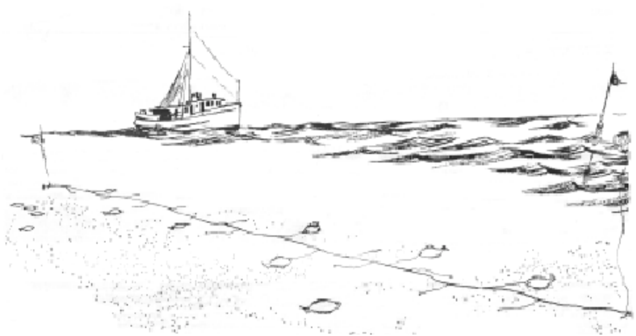
The size of the codend is related to the amount of fish that can be captured and held at any one time. In the early years of the whiting joint venture fishery (e.g., with the USSR and Poland), the processing ships produced fillets and headed/gutted products. Both the size of deliveries and the rate of delivery were controlled to match the processing rates. Production rates were limited by the equipment to prepare these products, and bruised, crushed whiting were too difficult to cut. American catcher vessels were required to make small deliveries using relatively small codends (compared to those used later by vessels delivering to processing ships that produced surimi). In an attempt to keep the high-volume surimi operations out of the whiting fishery (in order to maintain a longer season), some U.S. fishers proposed setting a limit on the size (volume) of codends that could be used. The suggested regulation was not approved for several reasons including the allocative effects and impact on economic efficiency. Effects of small trip limits, need for reduced harvest of overfished stocks, and bycatch reduction requirements may provide justification to consider adoption of size restrictions for bottom trawls.

<u>Chafing gear</u> - Chafing gear is used to protect the underside ("belly") of the net, including the codend. The types of material used for chafing gear are restricted by regulation to prevent reducing the effectiveness of minimum mesh regulations (i.e., reducing selectivity). Currently (2003), further restrictions are placed on chafing gear in conjunction with the small footrope requirement to reduce the use of trawls in rocky, rough-bottom seafloor areas.

<u>Bottom versus pelagic</u> - Bottom trawls and pelagic/midwater trawls have different uses and selectivities that can be used to

achieve certain bycatch reduction objectives. For example, a requirement to use pelagic trawls (which must have unprotected footropes and no chafing gear) would greatly reduce the encounter with animals that live on or in the seafloor. However, the use of large midwater nets could increase the encounter rate with pelagic species that should be avoided.

Bycatch reduction devices (BRDs)- Bycatch reduction devices, as they apply to trawls, are mechanisms that guide or force unwanted species or sizes out of the net and reduce the likelihood they will be captured. They are gear selectivity devices. BRDs have been effective in reducing catches of halibut in certain groundfish trawl fisheries in Alaska. BRDs are also used in other regions to mitigate trawl bycatch of turtles, finfish and other animals. In particular, they are used in West Coast trawl fisheries for pink shrimp and prawns to reduce bycatch of canary and other rockfish. Often BRDs reduce catch rates of the target species, but in some cases fishers can improve gear performance with experience and practice. BRDs have not been investigated in the West Coast groundfish trawl fishery. However, development of effective rockfish excluder devices could result in increased catches of other species.



Hook-and-Line

West Coast commercial and recreational fishers use a variety of hook-and-line gears. This diversity of gear types is a result of the diversity of fisheries (fishing strategies) targeting various species in the region. The specific hook-and-line gear design used is typically a result of whether the target species or species complex lives on the seafloor or higher in the water column and whether it is sedentary or mobile. Many commercial groundfish vessels are included in the federal groundfish limited licence program for stationary (fixed) longline gear. Another name for this is setline gear. Vessels typically fish this gear along the ocean floor for sablefish (blackcod) and/or Pacific halibut, but may take other groundfish and non-groundfish species also.

Other hook-and-line gears are considered "OPEN ACCESS" which means any commercial fisher (including limited entry vessels) may use them in accordance with state or federal regulations. (Fixed longline gear may also be used by any commercial groundfish vessel, but harvest levels are restricted). Some hook-and-line gear is pulled (trolled) through the water; other longline gear extends vertically from the surface towards the bottom and may drift with the current. Rod and reel is included in the hook-and-line category; this is the typical recreational gear type.

Potential tools to mitigate hook-and-line gear bycatch

Potential tools for mitigating hook-and-line gear bycatch include the number of hooks, whether the gear is stationary ("fixed"), pulled (trolled) or free-drifting, the type and size of hooks, how the fixed gear is marked/labeled, maximum length of the line, and how long it may be left unattended. In addition, bycatch reduction devices (BRDs) have been found to reduce bycatch of seabirds in other fisheries by making baited hooks less available or less attractive to birds feeding nearby.

Number of hooks - For the recreational fishery, limits on the number of hooks have been used to reduce the potential catch of overfished rockfish. This is not a selective method to protect any particular species, but rather it reduces the potential catch of all species that might be taken. It may be used in combination with other restrictions, such as the amount of weight that may be attached to the line, and the number of fishing rods an individual may use.

Stationary (setline) versus mobile gear - Mobile gear is being defined here as all hook-and-line gear that is not anchored at both ends, and it includes a variety of configurations. The distinction is used primarily for setting separate trip limits for limited entry and open access sectors. However, these gears often have substantially different selectivity and applicability. For example, setline gear cannot be effectively used to catch many pelagic (off-bottom) species. It can be fished throughout the water column and need not contact the seafloor, although some mobile line gear does contact the bottom (for example, "dingle bar" gear typically is bounced along the seafloor). Vertical longlines (sometimes called "Portuguese" longlines) are multi-hook lines, weighted at the bottom, that hang vertically from a vessel or a float, drifting with the current. "Fly" gear is trolled nearer the surface. Also, a variety of hook-and-line gear is used to catch nearshore (shallow water) groundfish and other species for the "live fish" market.

Type and size of hooks - Hook size and type can affect selectivity. For example, commercial sablefish fishers now use "circle hooks" because they tend to retain more fish and to hook the fish more in the "lip" rather than deeper in the mouth. In earlier years, the "J hook" was the primary gear. The use of small hooks can increase selectivity for small-mouth fish (such as sand-dabs, a type of flatfish) and avoid larger-mouth rockfish. Also, barbless hooks are required in some (non-groundfish fisheries) to improve survival of fish that must be released. Where the species suffer from *BAROTRAUMA* (pressure change), barbless hooks have little utility.

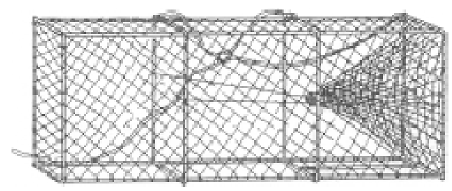
Gear marking (identification) requirements - Federal regulations require that fixed-longline gear be clearly and visibly marked at both ends with the vessel or fisher's identification and with a flag, radar reflector, etc. (Other line gears do not have this requirement because they are not left unattended.) Marking requirements serve both a safety and enforcement function. The safety requirement is that the gear be marked so it does not present a navigation hazard (collision or entanglement). The identification is so the owner of any lost or illegal gear can be identified. These requirements have little if any affect on bycatch other than to aid in recovery of lost gear.

Gear retrieval requirements - Baited setlines continue to fish as long as any hooks remain baited. At the end of the fixed-gear sablefish season, vessels may be required to "stop fishing" at a specific time. Retrieving gear is a fishing activity, so a "stop fishing" order means any gear must be left in place. Typically, after a specified period of time, the gear may be retrieved, although it may be necessary to release any fish. Any fish that must be released are considered bycatch. To prevent excessive bycatch of this type, gear must be retrieved within a specified period of time, unless the vessel is incapable of retrieving it (for breakdown, weather or safety reasons).

Bycatch reduction devices (BRDs) - Bycatch reduction devices, as they apply to longline fisheries in other regions, are devices that deter seabirds from chasing baited hooks as the gear is set. One general method is to deploy the gear through a tube that extends below the water surface; another general method is to use flags or other objects that intimidate birds from chasing the bait. Thus, the BRDs reduce the likelihood seabirds will be killed. This is particularly important for listed species such as short-tailed albatross. Seabird deterrents devices have been effective in reducing seabird bycatch in Alaska groundfish longline fisheries and Pacific Ocean pelagic longline fisheries. The need for seabird BRDs has not been investigated in the West Coast groundfish longline fishery. The NMFS Observer Program records information on groundfish longline-seabird interactions; that information will be evaluated to determine the number of seabird mortalities and the need for BRDs.

Pot/Trap

The words "pot" and "trap" are used interchangeably to mean baited cages set on the ocean floor to catch various fish and



shellfish. They can be circular, rectangular or conical and may be set out individually or fished in strings. All pots contain entry ports that allow fish to enter. Current regulations require that all pots used for groundfish must have biodegradable escape panels or fasteners that are intended to disable the trap if it becomes lost or abandoned. Otherwise, lost traps could continue to capture fish, a condition known as "*GHOST FISHING*." Individual groundfish pots must be marked at the surface; strings of pots must be marked at each terminal end with a pole and flag and a light or radar reflector.

Traditionally, groundfish pots have been used on the West Coast primarily to target sablefish. Commercial groundfish pot gear is included in the federal groundfish limited licence program for stationary (fixed) gear. Vessels typically fish this gear along the ocean floor for sablefish. Pots are also considered an "open access" gear, which means any commercial fisher (including limited entry vessels) may use them in accordance with state or federal regulations. Trap gear is also used to target live fish.

Potential tools to mitigate pot gear bycatch

Potential tools for mitigating pot bycatch include size and shape, mesh size, number of pots, how the gear is marked/ labeled, requirements to prevent "ghost fishing" if the trap is lost, and how long gear may be left unattended (retrieval time requirements).

Size and shape - Larger pots potentially can capture and hold larger numbers of fish, but typically would not affect the species mix. Setting a maximum pot size would thus not affect selectivity but would affect harvest capacity. There are no groundfish pot size restrictions at this time.

Mesh size - The mesh size of a trap is related to the size of fish the trap will retain. Mesh size can be adjusted to select for fish of different sizes. Larger mesh increases the chances for small fish to escape. Smaller trawl mesh catches more small fish along with the larger fish. There are no mesh size restrictions at this time.

Number of pots - A maximum number of pots an individual fisher or vessel may use can be specified. The effect of "pot limits" is to reduce individual and/or fleet capacity. This can be useful in highly overcapitalized fisheries to slow the pace of the "race for fish" and to reduce bycatch during closed seasons (for example, after the season closes). There are no groundfish pot restrictions at this time.

"Escape panels" - Escape panels create an opening in the pot to allow fish to escape. This is important because a pot can continue to "ghost fish" as long as it remains in the water. The size of the opening can be regulated, as can be the material that creates the opening. For West Coast groundfish, the federal regulation specifies the use of biodegradable twine (sometimes called "rotten cotton") that should disintegrate if the pot remains in the water too long.

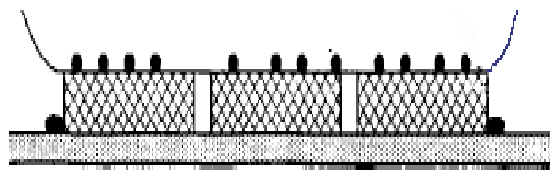
Gear marking (identification) requirements - Federal regulations require that groundfish pots must be clearly and visibly marked at both ends with the vessel or fisher's identification and with a flag, radar reflector, etc. (Other line gears do not have this requirement because they are not left unattended.) Marking requirements serve both a safety and enforcement function. The safety requirement is that the gear be marked so it does not present a navigation hazard (collision or entanglement). The gear identification is so the owner of any lost or illegal gear can be identified. These requirements have little if any affect on bycatch other than to aid in recovery of lost gear.

Gear retrieval requirements - Baited pots continue to attract and catch fish as long as they maintain their structural integrity. At the end of the fixed-gear sablefish season, vessels may be required to "stop fishing" at a specific time. Retrieving gear is a fishing activity, so a "stop fishing" order means any gear must be left in place. Typically, after a specified period of time, the gear may be retrieved, although it may be necessary to release any fish. Any fish that must be released are considered bycatch. To prevent excessive bycatch of this type, gear must be retrieved within a specified period of time, unless the vessel is incapable of retrieving it (for breakdown, weather or safety reasons).

Unbaited pots may also attract fish because they may provide "structure." Pots left on the grounds after the end of the season will continue to ghost fish unless they are de-activated by leaving an open escape route such as an open door or escape panel. Any fish left in a closed trap eventually die and become bait for other fish. By requiring that pots be removed soon after the end the season, this can be minimized.

Setnets are not legal groundfish gear north of 38° N latitude (near San Francisco, California)

Setnet (Gill and Trammel Nets)



[The Groundfish FMP recognizes setnets as legal groundfish gear only in California south of Point Reyes (near San Francisco). Regulations controlling their configuration and use are implemented by the State of California. The FMP does not allow the use of drift nets for taking groundfish, nor does it allow the use of setnets in other areas. Potential management tools are listed below but are not described.]

Setnets are flat, rectangular nets that hang vertically in the water from a buoyed cork line and weighted along the bottom with a lead line. Setnets must be anchored, and they hang fairly vertically in the water column. They tend to bulge under the effect of currents. The nets are intended to be slack rather than taut, because fish swimming into a taut section of webbing tend to bounce away rather than become entangled. Nets are made of a lightweight multi-filament nylon or monofilament strands with certain specific mesh sizes to select the catch. Mesh size of gillnets is selected so the heads of the desired fish go through the mesh, but their bodies do not. When a fish tries to escape it tends to become entangled in the net.

A **trammel net** is a net made with two or more walls joined to a common float line. The inner net is made of smaller mesh and hangs deeper than the outer webbing. Fish pass through the outer webbing, strike the inner webbing and carry through to the larger webbing on the opposite side. Fish thus become trapped in the pocket formed by the intertwined webbing.

Potential tools for mitigating setnet bycatch include mesh size, size (height and length), number of panels, how the gear is marked/labeled, how long gear may be left unattended, and where it may be used.

Time/Area Restrictions (Closures)

Time/Area Restrictions (including closures, marine protected areas and reserves)

Closures, as a management tool, have both a spatial (area) and temporal (time) dimension. Some area closures are long term to address a long term problem or condition. Examples of this would be to protect areas with special habitat, historical significance, or scientific or other value. Marine reserves are an example of a long-term area closure where all or certain activities may be restricted, depending on the objective and designation. Short term closures may be for an entire region (such as a season) or for a more localized area (such as a spawning area to protect eggs and/or young when they are present).

In recent years, area closures based on depth contours have been used to reduce the likelihood certain overfished groundfish species might be caught. This approach may be especially effective for species (cowcod, for example) that are relatively sedentary, that move only short distances. Often, however, juveniles concentrate at different depths or habitats than adults, and in some cases may be caught in different fisheries or by different gear types. Some species migrate seasonally; a permanent area closure would have to consider the entire migratory range, while a seasonally-adjusted or moving closure might provide a similar degree of protection while allowing greater fishing opportunities for other species. Also, where multiple species are in need of protection, the individual distributions must be taken into account.

NMFS regulatory guidance on EFH suggests time/area closures as possible habitat protection measures. These measures might include, but would not be limited to: closing areas to all fishing or specific equipment types during spawning, migration, foraging, and nursery activities; and designating zones for use as marine protected areas to limit adverse effects of fishing practices on certain vulnerable or rare areas/species/life history stages. To the extent that such an identified species or assemblage is taken as bycatch in the groundfish fishery, area closures may be an effective bycatch reduction approach.

Capacity Limits

Capacity Limits

Capacity limits are used to restrict access to the fish resource. Tools to limit capacity include permits and licenses and are intended to restrict the number of participants in a fishery. (They also serve as a mechanism to monitor participation in the fishery.) The maximum number of commercial longline, pot and groundfish trawl vessels participating in the limited entry fisheries was set by the license limitation program that took effect in January 1994.

"Fishing power" is also a term sometimes used to describe capacity that is managed with the use of gear restrictions and other tools. Permits and licenses can be used in a number of ways to limit capacity. A permit can specify the type of vessel or gear that may be used, the amount of fish that may be caught or retained, or who may do the fishing. That is, permits can apply to vessels, gear or fishers, and the number of permits can be limited. All groundfish limited entry permits designate the maximum length overall (LOA) of the vessel. Permits may be combined and applied to a larger vessel in accordance with a formula established in the limited entry regulations. Once combined, permits cannot be separated.

Once the number of permits has been limited, as in the West Coast groundfish fishery, it may be necessary to reduce the number of participants in a fishery. This can be accomplished through a "buyback" program, by the government cancelling or revoking permits, or by requiring participants to obtain multiple permits (for example, buying them from other fishers/vessels or joining into cooperatives). A trawl buyback program was completed late in 2003, resulting in the elimination of 91 trawl permits and vessels, roughly 37% of the trawl fleet. This result is less than the 50% reduction called for in the Council's Strategic Plan, and it addresses only the trawl fishery. The trawl sector is still categorized as over-capitalized.

Vessel Restrictions

Vessel Restrictions

Restrictions on the type, size and/or power of a fishing vessel can be used as a management tool, typically to address fishing capacity. In the West Coast groundfish fishery, only vessel length is restricted. Vessel restrictions in themselves often have limited effect on capacity or "fishing power," and many potential vessel restrictions are rarely used because they are easy to circumvent. Combined with other tools, they may be an effective means of achieving a particular management goal, although the effectiveness may be difficult to predict.

Data Reporting, Record-keeping, and Monitoring Requirements

Data Reporting, Record-keeping, and Monitoring Requirements

Data Reporting, Record-keeping, and Monitoring
Monitoring and reporting requirements are essential fishery management tools. Without monitoring and reporting, there is no effective measure to either ensure compliance with the tools used or to determine if the bycatch mitigation tools have been effective. Monitoring and reporting tools include permits/licenses, registration, fish tickets, logbooks, port sampling/onshore observers, on-board observers, *VESSEL MONITORING SYSTEMS* (VMS), onboard video recording devices, surveys, punch cards/tags, and enforcement activities. The current federal reporting requirements include permits/endorsements for the limited entry sector of the commercial fleet, reporting requirements for the at-sea whiting fleet (catcher/processor and mothership/processor vessels), an onboard observer (scientific data collection) program, and a VMS program beginning in 2004. Federal licenses are not required for the commercial open access sector or for the recreational sector. The current fish ticket and commercial logbook reporting requirements are conducted by the states.

Permits/licenses/endorsements - Permits and licenses confer permission to conduct specified activities. For fisheries, they may be a registration of vessel or gear, species, amounts, etc. There may or may not be a limited number of licences/permits available, and there may or may not be a cost to obtain them. In the groundfish fishery, trip limits apply to vessels rather than to permits. Endorsements are added to permits to provide specific conditions or permissions. For example, each limited entry permit includes a vessel length and gear endorsement. Also, a sablefish endorsement was created to identify those longline and pot vessels eligible to participate in the "primary season" and the amount of sablefish they may harvest during the season.

Registration - Vessels may be required to report in advance their intention to fish in a certain area, fishery, time period, etc. This provides a record of intention and may confer permission. NMFS published (in 2003) a final rule to require that operators of any vessel registered to a limited entry permit and any other commercial or tribal vessel using trawl gear, including exempted gear used to take pink shrimp, spot and ridgeback prawns, California halibut and sea cucumber, to declare their intent to fish within a conservation area specific to their gear type, in a manner that is consistent with the conservation area requirements. That is, the vessel must notify a state or federal agency before it enters an area closed to fishing.

<u>Fish tickets</u> (commercial landings/sales receipts) - Fish tickets are a record of the amount and species of fish landed by a commercial fishing vessel. They are required by each state, and the information required may differ among states. Typically, fish tickets may also indicate gear used, area fished and other specified information. This information is entered into an electronic data system and transmitted to a centralized database (PacFIN, maintained by PSMFC).

<u>Vessel logbooks</u> - Logbooks are a vessel's record of activities and estimated amounts of fish caught and retained. The trawl logbook program is conducted by the states (with the help of PSMFC). Vessels are required to complete and submit these records as specified by state regulation. Fishing location is required, as well as amounts of fish retained in each set/haul/tow. Currently, only retained catch is recorded. Selected logbook information is keypunched into an electronic database and compared to fish ticket records. Although states require some non-trawl vessels to fill out logbooks, only trawl logbook information is entered into the federal data system. Electronic logbooks are used in some fisheries.

<u>Surveys</u> - Surveys are a series of questions, verbal or in writing, designed to collect useful information. Surveys may be conducted in person (as in a port sampling survey), by phone (as in the survey of recreational fishing), or by mail. Typically, participation in a survey is voluntary.

<u>Punch cards/tags</u> (recreational) - Punch cards and tags may serve as a license/permission and as a catch record. There are no federal requirements at this time for West Coast groundfish.

<u>Port sampling/on-shore observers</u> - When a vessel or fisher returns to port, he/she may be met by an official surveyor who collects specified fishing-related information. This may be biological information about the fish, fishing locations and methods, ocean conditions, marine animals observed, etc. Species information may be incorporated into the data system to

provide more specific information than recorded by other methods. For example, a fish ticket may not record the weight of each species or even a complete list of species, but a port sampler/observer may provide that information. Port sampling is typically conducted by the states, in conjunction with *PSMFC*.

On-board observers - Commercial vessels fishing for groundfish are required to allow an agency-certified fishery observer aboard to collect scientific information. The current federal observer program for the West Coast groundfish fishery has resources to observe about 10% of the commercial (limited entry) groundfish fishing trips. Currently, the West Coast observer program focuses on discarded fish, recording amounts, species, and some biological information about the fish. Other information, such as time, location, and gear may also be recorded. Observers can also record observations or measurements of seabirds and marine mammals and other useful scientific information. The federal observer program is not intended or designed to be a compliance or enforcement program.

A compliance monitoring program could be established, as in conjunction with an individual fishing quota program, to help ensure vessels maintain appropriate records and comply with the fishery management program requirements. For example, a compliance monitor could record discarding activities and fishing location.

Vessel monitoring systems (VMS) – A mobile vessel monitoring system (VMS) is a tool that allows vessel activity to be monitored in relation to geographically defined management areas (PFMC 2003e). VMS transceivers automatically determine and report the vessel's position using Global Positioning System (GPS) satellites. Generally, the vessel's position is determined once per hour, but the position determinations may be more or less frequent depending on the fishery. VMS transceivers are designed to be tamper resistant. In most cases, the vessel owner is not aware of exactly when the unit is transmitting and is unable to alter the signal or the time of transmission. VMS is a technological tool that can be used to improve bycatch management by providing location data that can be used in conjunction with observer data collections. (See the 5/22/03 *Federal Register* "Proposed Rule for a Vessel Monitor System" for additional information.)

Onboard video recording devices, sometimes called Electronic Monitoring, are used in some areas to monitor vessels' fishing activities. Cameras mounted on vessels can record fishing times and provide a general view of catch, as well as certain fishing-related activities. Limited bycatch (discard) and species composition information can be obtained by this method. (See Appendix C for additional information.)

Enforcement activities include a variety of data collection methods and information. Traditional techniques used to monitor marine fisheries include monitoring from air and surface craft. Monitoring from aircraft provides fishing location, vessel counts, and other general information. It could provide only limited bycatch information, such as whether discarding has occurred (such as visible, floating fish).

4.1.5 General Effects of Bycatch Mitigation Tools

Catch is related to fishing effort, selectivity of the fishing gear and methods, and species abundance. Reducing unwanted catch is the highest priority in a bycatch mitigation program.

Catch is related to fishing effort, selectivity of the fishing gear and methods, and species abundance. Reducing unwanted catch is the highest priority in a bycatch mitigation program. Bycatch mitigation tools or management measures vary in their application and effect at reducing bycatch, bycatch mortality and in improving catch accountability. Few tools have only one effect, and thus it is often a case of choosing tools that effectively address a variety of goals. Likewise, it is important that the chosen tools work in harmony to achieve the objectives, rather than work in opposition to each other. In theory, an optimum management program would use a few tools that work together synergistically to achieve the desired effects. In this EIS, traditional tools and some new tools never before used in managing West Coast groundfish fisheries are evaluated.

Tools and Their Linkage to Species Associations

Tools and Their Linkage to Species Associations

The utility, effects, and effectiveness of various management measures are linked to key attributes of species we seek to manage. Some tools are more effective at reducing bycatch of rockfish than flatfish for example. Other tools designed to reduce the bycatch of one species may have different impacts on another species. In this EIS, example groundfish species have been highlighted for the analysis. These include all of the overfished groundfish species and selected emphasis groundfish species representing a sample of the over 80 groundfish species managed under the Groundfish FMP. These species represent a cross section of groundfish, and have differences in stock status, behaviors, life history, and habitat associations.

Table 4.1.0. Species Associations and Attributes Important to Application of Bycatch Mitigation Tools

Overfished
- **Canary rockfish**
- **Lingcod**
- **Yelloweye rockfish**
- **Bocaccio**
- **Cowcod**
- **Widow rockfish**
- **Pacific Ocean perch**
- **Darkblotched rockfish**
- **Pacific whiting (in review)**

Rocky-bottom shelf habitat
- **Canary rockfish**
- **Lingcod**
- **Yelloweye rockfish**
- **Bocaccio**
- *Yellowtail rockfish*
- *Chilipepper*

Non-rocky shelf habitat
- *Dover sole*
- *English sole*
- *Petrale sole*
- *Arrowtooth flounder*

Slope
- **Darkblotched rockfish**
- **Pacific Ocean Perch**
- *Dover sole*
- *Sablefish*
- *Shortspine thornyhead*
- *Longspine thornyhead*

Pelagic or Semi-pelagic
- **Widow rockfish**
- **Pacific whiting**
- *Yellowtail rockfish*

Nearshore
- *Black rockfish*
- *cabezon*

Migratory
- **Pacific whiting**

Longevity
- Rockfishes - longest
- Flatfishes - intermediate
- **Lingcod** and *cabezon* - intermediate
- **Pacific whiting** - shortest

Productivity Index
- Rockfishes - very low
- Flatfishes - low
- **Lingcod** and *cabezon* - low
- **Pacific whiting** - low

Handling survivability
- Rockfishes, Pacific whiting - little or no survival
- Flatfishes - some survival escaping from mesh
- **Lingcod**, *cabezon*, sablefish - some survive release

Overfished species - **Bold**, Emphasis species-*italic*

Several other important non-groundfish emphasis species have also been chosen for the analysis.

Knowledge of species attributes is key to understanding if a tool can be used to reduce bycatch and how effective it will be. For example, several of the overfished groundfish species are rockfishes that have a high degree of association with rocky-bottom shelf habitat (see Table 4.1.1). Some of these habitats are well defined areas on the continental shelf. Area management tools (such as MPAs or the current RCAs) may be very effective at controlling vessel encounters with concentrations of canary rockfish and cowcod. However, canary rockfish also occur outside of present RCA boundaries in lower concentrations, and thus area management alone may not minimize incidental encounter with them. A combination of area management and other tools may be more effective in minimizing incidental canary rockfish catch.

Lingcod is another overfished species which is associated with rocky-bottom shelf habitats and partially overlap canary rockfish distribution. However, lingcod are also found in non-rocky bottom and nearshore habitats. Area management tools designed to protect canary rockfish will reduce encounters with lingcod within the canary management area, but to minimize lingcod bycatch, additional measures (or area) would be necessary.

Many species have a much broader distribution across shelf and slope habitats. Generally, younger fish settle in shallow water areas and gradually move offshore as they mature. Others make small scale seasonal migrations to feed on the shelf during the summer or spawn offshore in the winter. Lingcod move inshore to spawn during the winter.

Flatfishes as a group are broadly distributed, while Pacific whiting make extensive migrations between southern and northern limits of their range.

Because they are so broadly distributed, area management tools would have to be extremely broad and greatly reduce areas for fishing for other species. Gear restrictions, on the other hand, could be used to for flatfish, and seasonal restrictions on Pacific whiting to do so.

Another important attribute to be considered in designing and applying bycatch mitigation tools is a species' sensitivity to handling. Rockfishes have swim bladders that expand to the point of bursting when they are brought to the surface from seafloor depths greater than a few fathoms. Few rockfish survive this kind of trauma. Thus, regulations that require release of rockfish will likely result in near 100% bycatch mortality. Species that lack swim bladders, such as lingcod and cabezon, appear to be more durable and may be less traumatized by capture and release. Size, bag and trip limits may not contribute to high bycatch mortality rates for these species.

Effects of Bycatch Mitigation Tools

Effects of Bycatch Mitigation Tools

The primary components of bycatch that can be "managed" are through harvest levels, gear, who, when and how many (that is, which vessels, times and areas, and capacity (number of vessels and characteristics of those vessels). Other tools include monitoring/ reporting requirements. These tools have different effects on mitigating for incidental catch, bycatch, bycatch mortality, and accountability . The following is a description of the range of effects for different management tools.

Harvest Level Specifications: ABCs, OYs and Allocations

Harvest Level Specifications: ABCs, OYs and Allocations

Harvest specifications (such as ABC, TAC, MSY and OY) are the first level of conservation and management to maintain sustainable fisheries. For West Coast groundfish, harvest specifications are set to either maintain or rebuild various stocks. When stocks are not equally available (or available in the same proportions), specified harvest levels may not match the relative abundance (ratios) of all the species. OYs are the annual harvest targets for groundfish. Other management measures are designed to achieve but not exceed those targets. OYs provide the basic framework for management, but the fishery management measures to achieve them have more direct relationships to incidental catch and bycatch.

A relatively small OY for an incidental species, in conjunction with larger OYs for target species, may generally result in an increased probability and level of regulatory induced discard. Exceptions to this have to do with the distributional characteristics of the species and other management measures that might be applied. A widely dispersed species with a small OY is likely to have a higher encounter rate when fishers target other co-occurring species. Most of an OY would likely be used as incidental catch allowance for fisheries directed at co-occurring species.

Allocations of OY at the highest level (to major limited entry gears, open access, and recreational fishers) will also have potential impacts on bycatch due to differing selectivity of gears involved. Other tools, discussed below, may be used to mitigate for fishing impacts of small OYs.

The balance of OY and fleet size/capacity is critical to bycatch. If a stock is very abundant, and few vessels or anglers fish for it, there is unlikely to be any regulatory discard. However, any abundant stock that is underutilized is likely unmarketable. A large stock biomass in conjunction with a large (but not overcapitalized) fleet can also result in very low regulatory discard. Even a small stock in conjunction with a small fleet may not have much regulatory discard. However, if that stock is mixed with abundant but unwanted species, the level of economic (non-regulatory) discard may be excessive.

And finally, a species may have a large ABC but also have harvest constraints to reduce impacts on a small OY species. The result would likely be a large regulatory discard. This is a result not of the OY directly, but rather the management measures to achieve two or more OYs that are “out of balance.” This is the case with species such asyellowtail rockfish that have large OY levels but which have their catch constrained by co-occurring species with a smaller OYs such as canary and widow rockfish.

For other species with relatively large OYs, bycatch may not necessarily decrease, as there are many non-regulatory sources of bycatch that are proportional to the size of catch. Some non-regulatory sources of bycatch are related to market limits on fish size, quality, and quantity. Another different set of tools may therefore be needed to reduce non-regulatory forms of bycatch that are associated with species having high OYs.

Trip Limits, Bag Limits, and Catch Limits

Trip Limits, Bag Limits, and Catch Limits

Trip limits are retention and landing limits (by species or species complex) that apply to individual commercial fishers, vessels, permits, gear groups, or other defined groups in a given area for a given period of time. Bag limits are the equivalent for recreational fishers.

In a study of West Coast groundfish, discard rates were found to vary inversely with the size of the trawl trip limits imposed (Pikitch *et al.* 1988). Restrictive limits may therefore result in a higher catch and bycatch mortality of overfished species compared to alternatives that provide larger trip limits, or alternatives that use a different set of management tools. Vessel trip limits for overfished species are typically designed to allow for retention of small, non-targeted amounts that are caught incidentally. In a few cases, limited target fishing for some overfished species may be allowed with some gear types during part of the fishing year, such as for Pacific whiting, widow rockfish, and lingcod. Cumulative 1 or 2 month limits are used to help minimize regulatory discard.

Trip limits are often structured to preserve a ratio of catches reflective of a fishing strategy that results in a particular mixture of species. Often times the mixture contains one or more species that is either overfished or under precautionary management. Catches are constrained so that the ratio is preserved and the overfished or precautionary species OY is not exceeded. Fishers may attempt to develop strategies to maximize value of joint catches of the mixture. If actual fishing experience on the grounds and optimal values for a species mixture matched the average ratios applied when trip limits are set, regulatory bycatch should be minimized. Catches of individual species tend to be highly variable, leading to a significant tow-by-tow and trip-by-trip variation in ratios. Although rare, there are times when an encounter with an isolated school of rockfish can lead to bycatch that is several times larger than the incidental catch limit. This problem (which is sometimes referred to as a “disaster tow”) can be significant for overfished rockfish with a trip limit set at a low level.

In an analysis of Oregon *ENHANCED DATA COLLECTION PROGRAM* (EDCP) observer data, a small percentage of the trips were found to be responsible for a large fraction of discard (Methot *et al.* 2000). Similar variability in bycatch rates of darkblotched rockfish occurs in the shoreside based whiting fishery. The rare "disaster tow" can have 2,000 times the low end of the range of variability of darkblotched bycatch (PFMC 2003d). This high degree of variability is related to the aggregating nature of some of the species in the mixture (see above discussion on species associations).

In addition, market forces stemming from price, quantity, and size may result in fishers seeking an alternative mixture of species. Catch of undersized or lower valued species can, therefore, be coupled with regulatory limits leading to discard. This problem generally increases with smaller limits. In the same analysis of EDCP observer data, predicted discard was found to be an increasing function of the amount of DTS complex landed and a decreasing function of the remaining limit available for that species (Methot *et al.* 2000).

Some fishing strategies do not take significant amounts of overfished species. The amount of overfished species varies between strategy, target species, and overfished species (See Tables D-5 through D-13 of Proposed Acceptable Biological Catch and Optimum Yield Specifications and Management Measures for the 2004 Pacific Coast Groundfish Fishery (PFMC 2003d)). Trip limits on some species of groundfish may not result in significant regulatory discarding, as many of the trips fall short of the cumulative limits. On the other hand, market factors such as size, quantity, quality and price limitations may also lead to discard if fishers continue to fish for other more valued species.

During three years of the EDCP study (1997-99), onboard observers attempted to record the reasons for discarding a species. "Market" was listed 66% of the time, followed by "regulations" at 24% and "quality" 10% of the time (Saelens and Creech 2003), for all species discarded. Regulations were cited as the primary reason for discarding overfished species, whereas market conditions were cited as the primary reason for discarding other emphasis species except for sablefish and shortspine thornyheads. Regulations were given as the primary reason for discard of these two species (Table 4.1.0b).

Table 4.1.0b Reasons given for discard during three years (1997-99) of the Oregon Enhanced Data Collection Project (EDCP). Percentages based on recorded reasons for discard of species (market, quality, or regulation). Species discarded for an unspecified or unknown reason were not included in record count. Enviroment refers to classification given for species used in EIS analysis, not necessarily the location where the reason for discard was determined by the EDCP observer. Overfished species in **bold** and emphasis species in *italic*. Species below MSY and under precautionary management are noted with (p).

		1997-99			
Environment	**Species**	**Number of EDCP Records**	**Market**	**Quality**	**Regulation**
Northern Shelf	**Canary rockfish**	31	0%	3%	97%
	Lingcod	309	6%	2%	93%
	Yelloweye rockfish	0			
	Yellowtail rockfish	66	20%	9%	71%
	Arrowtooth Flounder	115	91%	9%	0%
	English sole	214	74%	25%	0%
	Petrale sole	29	100%	0%	0%
Southern Shelf	**Boccacio**	0			
	Cowcod	0			
	Chilipepper	12	100%	0%	0%
Slope	**Darkblotched rockfish**	0			
	Pacific Ocean Perch	3	0%	33%	67%
	Dover sole (p)	645	58%	16%	25%
	Sablefish (p)	1,163	9%	8%	83%
	Shortspine thornyhead (p)	514	39%	7%	54%
	Longspine thornyhead	336	82%	11%	7%
	Unsp. thornyhead	208	50%	16%	34%
Pelagic	**Widow rockfish**	41	37%	0%	63%
	Pacific whiting	962	88%	11%	2%
Nearshore	*Black rockfish*	0			
	Cabezon	0			
Grand Total		4,648	48%	11%	41%
All Species Total Including Non-GF		8,920	66%	10%	24%

Since the EDCP study, cumulative limits and depth based management have significantly altered fishing conditions. Current information on the reasons for discard are not available. We make the following simplifying assumptions with regard to trip limit effects based on the discussion and past studies cited above:

- Trip limits affect the amount of trawl discard in particular, resulting in higher discard rates as trip limits decline. Such bycatch is more likely to be regulatory discard. Overfished species tend to have more restrictive trip limits. Therefore, we assume much of the overfished species bycatch becomes regulatory discard.
- Trip limits also regulate the catch of other groundfish in order to control the annual harvest goal or OY or to minimize impacts on overfished species. Fishers may optimize value while minimizing incidental take of a constraining species above the overfished level, or an overfished species. We assume a mixture of regulatory and market induced discard results in bycatch of these species.
- Some OYs and trip limits are liberal enough that fishers are primarily limited by market conditions. We assume that those species having liberal trip limits that can be taken without taking a high percentage of a constraining species are primarily discarded due to economic or market limiting reasons.
- Finally, trip limit management for West Coast groundfish has a 20 year history. We assume that there has been some amount of regulatory discard for any trip limit level. Some alternatives may result in increased trip limit size. While this may reduce regulatory discard, it will not eliminate it.

Bag and size limits in recreational fisheries contribute to regulatory discard. In nearshore (shallow) waters, bycatch mortality of rockfishes due to the effects of barotrauma are lessened. Some species subject to bag limits and size limits, such like lingcod and cabezon, can tolerate effects of hooking, handling, and release better than rockfish.

Catch limits are substantially different than trip or retention limits.

Catch limits (or fishing mortality limits) restrict the amount of fish that may be caught or killed, whether landed or discarded. These limits require fishers to stop fishing when a limit is reached. Catch limits have not been used in the federal groundfish management program because they would require extensive and expensive monitoring.

Catch limits, when effectively monitored and enforced, provide a very high incentive for vessels to develop methods to avoid restricted species. Vessel catch limits would apply either annually or to specified 2-month periods; sector limits would likely be annual. These limits may or may not be transferrable, and trip/catch limits may or may not expire at the end of each period.[3/]

At the September 2003 Council meeting, trawl and environmental representatives made a presentation on British Columbia's Individual Vessel Quota (IVQ) program. Prior to implementation of the IVQ program, harvest capacity and effort were increasing, which resulted in smaller trip limits for groundfish and high levels of unreported discard (Larkin *et al.* 2003). The presenters wanted to provide the Council, NMFS and other attendees with a clear description of an effective management program that resolved many economic and bycatch problems. Alternative 5 in this draft PEIS is modeled in large part on that Canadian program. The term *RESTRICTED SPECIES CAP* or *QUOTA* (*RSQ*) is used to designate an individual vessel quota for overfished species; an individual vessel quota for other groundfish called an *INDIVIDUAL FISHING QUOTA* (*IFQ*) or simply an individual quota (IQ). Generally, individual quotas allow managers to eliminate or minimize the use of trip limits as a management tool or to restrict fishing when quotas are reached. This has the potential to reduce regulatory induced discard, especially for overfished species. IQ programs generally work best in conjunction with extensive monitoring to ensure accountability in a catch accounting system. This typically means 100% observer coverage or other reliable catch verification system. When effectively monitored, catch limits (or catch mortality limits) increase the incentive to keep any useable fish.

A clear distinction must be made between retention quotas and catch or mortality quotas. Retention quotas are much less effective at reducing incidental catch, bycatch and discard. This is especially apparent where the value of different sized fish is substantial. In that case, high-grading would be likely, as a

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[3/] Under current definitions, trip limits apply to vessels rather than permits, and trawl vessels may have only one permit. By assigning trip/catch limits to permits and allowing vessels to have multiple permits, vessels could increase their catch amounts. This process is called "permit stacking." Without this or some method of transferring catch limits between vessels, a trawler could be required to stop fishing after even a single "dirty" tow.

fisherman (who is in the fishing business for his economic and financial benefit) will seek to maximize his profit. Retention limits can be effectively monitored on shore through landings receipts and sampling deliveries. Catch limits, on the other hand, must be monitored at sea. The exception to this is if discarding is prohibited; in that case, an onboard video system would be relatively effective in monitoring discard activities, but would not be effective in distinguishing which species are discarded.

Establishment of transferable IQs typically results in some level of industry consolidation. For example, a groundfish trawl IFQ program would likely result in fewer trawl vessels participating in the groundfish fishery. Some trawl quota share holders would likely elect to sell (or lease) shares and switch to some other fishery or stop fishing. Each of the remaining vessels would have a larger share of the resource on average. The impacts of this scenario are less easily resolved. By acquiring more quota shares of overfished species (that is, RSQs), a trawl fisher could increase his access to other groundfish.

Gear Restrictions

Gear Restrictions

Gear regulations are often intended to reduce the efficiency of the various gear types. Gear regulations can also be used to change the gear's selectivity. Gear selectivity is related to catch and bycatch, and thus selectivity can be adjusted to mitigate for the effects of fishing and reduce bycatch. Unobserved bycatch mortality may still occur even though bycatch as measured through observer programs is reduced. Gears can be modified to reduce the take of undersized fish, change the species composition, reduce the take of prohibited species, decrease overall efficiency, or force the gear to be used in particular habitats. Through the *EXEMPTED FISHING PERMIT* (*EFP*) process, fishers, agencies, and gear manufacturers are actively experimenting with modified gears designed to reduce the take of overfished species.

Trawl

West Coast commercial fishers use a variety of otter trawl types. Bottom trawls are used to fish for rockfish, flatfish, and sablefish. Gear restrictions on bottom trawl gear have had a significant impact on bycatch rates and amounts of overfished and other groundfish species. The minimum mesh size for trawl gear was increased from 4 inches to 4½ inches in 1995, based in large part on a mesh size study conducted in the late 1980s. The study demonstrated reduced retention of small, unmarketable groundfish. Larger mesh reduces the catch of undersized fish that would otherwise be sorted and discarded at sea. Changes in the type and use of chafing gear is also believed to have increased escapement of juvenile rockfish, flatfish and sablefish. However, there is likely to be some level of bycatch mortality for fish escaping through the meshes (Davis and Ryer 2003).

Large diameter roller gear has permitted bottom trawls to be used in hard bottom areas preferred by shelf rockfish species. Beginning in 2000, restrictions on the use of rollers larger than 8 inches effectively reduced directed rockfish fishing on these rocky-bottom shelf areas. A study by Hannah (2003) showed that trawlers avoided rocky reef areas on the shelf as a result of the regulation, and that encounter rates of overfished species were reduced.

EFPs are currently being used to test the selectivity of special flatfish trawls designed to reduce rockfish catches. These nets have large, cut-back sections of net in the upper panel of the trawl and reduced trawl height compared to conventional trawls. Preliminary results from an ODFW study using this experimental trawl in 50-180 fm indicated a 61% reduction in canary rockfish catch with an increase in flatfish catch rates (Parker 2003).

Other regulations could be used to change selectivity and efficiency of trawl gear. Smaller trawls could reduce bycatch by reducing the area swept by the trawl, which in turn would reduce bottom disturbance and catch. If navigation methods were sufficiently accurate, smaller trawls may be able to reduce contact with sensitive habitat species. Reduced trawl net height would reduce the capture of rockfish distributed in the water column above the bottom.

Most rockfish species do not survive after being brought to the surface after capture with trawl gears. Sablefish, cabezon, lingcod, and flatfishes (including halibut) lack swim bladders and have a better chance at survival. Thornyheads do not have a swim bladder, but are usually badly descaled due to contact with other fish and trawl webbing.

In addition to catching other non-groundfish marine finfish, all bottom trawls have some contact with the sea floor that results in the bycatch of benthic epifauna and shellfish. Marine plants, corals, sponges, sea urchins, and sea stars are taken as bycatch, some of which is unobserved. Bottom trawl doors, bridles and footropes also disturb rocks and sediments. Indirect impacts of this type of disturbance are poorly understood but are thought to reduce or modify fish habitats.

Midwater (pelagic) nets are used to target Pacific whiting and can be used to target semi-pelagic species such as widow and yellowtail rockfish. Pelagic trawls typically have lower bycatch rates of benthic organisms than bottom trawl gear.

Bycatch reduction devices (BRDs) are typically not used in West Coast groundfish trawls but are used by groundfish trawlers in Alaska (to reduce bycatch of Pacific halibut) and by West Coast shrimp and prawn trawlers (to reduce groundfish bycatch). Studies by the ODFW show a significant reduction in the bycatch of finfish species when fish excluders are used in shrimp trawls (Hannah *et al.* 1996). States currently manage the shrimp fishery and require the use of excluder devices to help reduce the take of canary rockfish.

Hook-and-Line

Hook-and-line gear refers to both stationary ("set") longlines and mobile or trolled hook-and-line gear. The gear may extend vertically or horizontally, and be on-bottom or off-bottom. Fish harvested with hook-and-line gear typically have minimal physical damage from the gear itself. Puncture wounds from hooks are often limited to the mouth and may result in relatively low mortality rates in released/discarded fish. Swallowed hooks result in higher mortality rates. De-scaling is a less typical effect, compared to trawl capture. Hook size and shape also affect the degree of injury. Physical stress resulting from rapid decompression, temperature change, exposure to air and physical handling result in some level of mortality.

West Coast commercial and recreational fishers use a variety of hook-and-line gears. Most West Coast groundfish set longline gear is used to target sablefish and coincidental catch rates of other groundfish are thought to be relatively low. Levels of discard or sablefish are currently being evaluated by the NMFS observer program. Sablefish is a relatively hardy species, but some hooking mortality occurs in released fish. Small fish or fish damaged by sand fleas or bites from predators typically make up the discard. A study of the Alaskan sablefish fishery indicated that sablefish bycatch as discard including bycatch mortality was less than 12% of the total allowable catch (TAC)

(Richardson and O'Connell 2002). In a comparison of sablefish pot and longline gear survey methods, Pacific rattail made up more than half of the total catch of all species in gear placed in deep water (600 fm) (Matteson *et al.* 2001). Most longline gear is fished shallower than this, and low bycatch rates were observed in this study.

Open access and recreational fishers use a diverse array of hook-and-line gears. Each gear type and configuration has its own selectivity characteristics, which results in different species mixtures. Fishers typically discard small fish and those with specified trip limits. Fish taken with hook-and-line gear, when released, have some chance of survival, depending on the species, depth fished, and other factors. Barotrauma (resulting from rapid depth decompression) inflicts high mortality rates for rockfish taken in deeper water. A study of different handling methods showed no significant difference in survival rates between quillback rockfish vented with a hypodermic needle or brought more slowly to the surface compared to un-vented fish or those brought more rapidly to the surface. Survival was significantly improved if fish were rapidly returned to depth (Berry 2001). Similar findings for black rockfish were observed by ODFW researchers (Rankin 2003). Mortality rates for lingcod, cabezon, and sablefish are less as they do not have swim bladders. However, ultimate survival of all of these species handled in such a manner is poorly understood.

Little information is available on encounter rates with marine bird species, and BRDs have not been required in the West Coast groundfish longline fishery. The NMFS Observer Program will provide better information on encounter rates. BRDs have been successfully used in longline fisheries in Alaska and elsewhere to reduce seabird mortality.

Pot/Trap

Pot gear causes minimal physical damage to fish. However, some level of predation (including cannibalism) occurs within the traps. In addition, physical strain resulting from rapid decompression, temperature change, exposure to air and physical handling result in some level of mortality.

Pot or trap gear is principally used to target sablefish in the West Coast limited entry fixed gear groundfish fishery. It is highly selective for sablefish. Bycatch in the commercial fishery is made up of undersized fish. A pilot survey study conducted by the ODFW comparing pot and longline gears indicated that sablefish made up more than 99% of the pot gear catch over a broad range of depths (Matteson *et al.* 2001). West Coast traps are typically equipped with 3½ inch mesh allowing escapement of some small fish. Some fishers use larger mesh in order to target larger sablefish that command higher exvessel prices.

Little is known about the mortality of released sablefish. Some studies indicate that bringing sablefish through an abrupt temperature change, such as the thermocline present offshore during the summer, can lead to stress and mortality (Davis and Ryer 2003).

Pot gear is also used by open access and limited entry participants in nearshore live fish fisheries. These small pots facilitate handling of fish and reduce injury so that fish will have a higher rate of survival when transported and held in the market place.

There is no limit on the number of pots that may be used in the limited entry fixed gear fishery. However, the State of Oregon limits the number of pots used by the only nearshore fisher holding a developmental fisheries pot permit for nearshore species to constrain effort.

Some ghost fishing can occur with lost pots and traps. To minimize losses gear is marked so it can be found and biodegradable lacing is required to disable any lost pot by creating a large hole as the lacing "dissolves." Mortality due to lost gear is not well understood or documented.

Setnet (Gill and Trammel Nets)
Mitigation tools used by the State of California for managing setnets are similar to those used for other nets. California placed observers onboard many vessels using setnets during the 1980s. Based on those observations, the State uses area restriction as a primary bycatch mitigation tool. Setnets are prohibited in areas where bycatch of marine mammals and seabirds was observed, especially in nearshore areas and feeding grounds. In addition, mesh size restrictions are used to reduce bycatch of small fish. Tools for managing setnets are not discussed here because this gear is managed by the State of California.

Time/Area Restrictions (Marine Protected Areas, No-take Reserves, Seasons and Closures)

Time/Area Restrictions (Marine Protected Areas, No-take Reserves, Seasons and Closures)

Time/area closures reduce bycatch by reducing fishing in areas where "restricted" species are most abundant. If the designated time/area restriction coincides with the majority of the species' population, capture of that species can be greatly reduced. This tool can be especially effective for localized populations of sedentary species. Time/area restrictions are less effective for mobile or migratory species and for species that are broadly distributed over large geographic areas.

Large scale, depth-based marine protected areas (MPAs), designed to protect several overfished species, are now in effect. (Some documents referred to these as Rockfish Conservation Areas or RCAs; other documents use the term Groundfish Conservation Areas or GCAs.) While these closures and restrictions have not been designated as "permanent," they are likely to remain in effect for several years as integral tools in strategies to rebuild overfished shelf rockfish. Little marine habitat is set aside as no-take marine reserves or research reserves, which are typically designated as long-term (permanent) areas closed to most or all fishing activities. Fishing activities in the RCAs, in particular on-bottom fishing, are restricted; fishing with certain gear types is still allowed.

Protected areas are best used when the migratory range of species is limited and species have strong site affinity for specific habitat types that can be identified and isolated through regulatory means. Protected areas have significantly reduced the bycatch of overfished canary rockfish, bocaccio, and cowcod. Seasonal restrictions can afford similar protection to species that aggregate during spawning migrations. Winter closures have been effective at reducing the catch of lingcod in nearshore spawning areas for example.

MPAs affect other species, both inside and outside of the boundaries. Catch of co-occurring species within an area is eliminated if the area is closed to all fishing activities. If some fishing is allowed, the amount of catch will be proportional to the effort, gear selectivity and abundance of the various species. If such an area encompasses the majority of a species population, only a small number of fish would be present outside the area. For that species, even if effort increases substantially the catch will remain very small. However, increased effort outside the closed area would result in increased catch of other species, again depending on selectivity and abundance.

Capacity Limits

Capacity Limits
Capacity limits are used to restrict access to the fish resource. Reducing capacity is a goal of the Council's *Strategic Plan for Groundfish*. Generally, capacity reduction in most forms reduces the need for other controls that may lead to regulatory induced bycatch in particular. Non-regulatory bycatch may also be reduced if there are fewer boats to supply market demands.

Capacity reduction is intended to reduce fishing effort; in the catch equation, if effort is effectively reduced, there is a proportional reduction in catch (if other factors remain constant). The problem is there is only a vague relationship between the number of vessels or fishers (or other standard effort measure) and the level of effective effort. Fishers, both commercial and recreational, tend to fish harder, change gear, change location, and learn from experience. Thus, few methods are effective at reducing effective effort, especially to a predictable degree.

IQ programs typically have a direct effect of reducing capacity if fishers sell their shares and leave the fishery. Impacts would be similar to other capacity reduction methods that consolidate vessel permits into a smaller fleet. By defining quotas as catch or mortality limits, catch is directly controlled regardless of other factors. Effective individual quota programs require close monitoring. However, this should be kept in perspective: any truly effective management program requires close monitoring.

Vessel Restrictions
The links between vessel size and fishing efficiency and capacity are very indirect, and thus size restrictions are not an effective tool for mitigating either bycatch or bycatch mortality. Likewise, horsepower and other vessel restrictions are similarly ineffective.

Data Reporting, Record-keeping, and Monitoring Requirements

Data Reporting, Record-keeping, and Monitoring Requirements
Monitoring and reporting requirements are essential fishery management tools. Accountability and accuracy of these programs is proportional to the amount of observer coverage and catch verification that can be accomplished. Higher levels of monitoring will yield more complete, accurate, and timely estimates of total catch including bycatch. Direct benefits would include in-season adjustments based on current season data and higher compliance rates. Indirect benefits would

include improved stock assessments and tracking of rebuilding plans.

Summary of Tool Effects and Rationale for Direct and Indirect Effects

The rationales for each tool used to describe direct and indirect effects are summarized in Tables 4.1.1 and 4.1.2. The rationales are based discussions above and on past studies and PFMC documents.

The potential impact of a tool on reducing bycatch and bycatch mortality may be due to direct or indirect effects. Effects and commensurate impacts vary according to tool and by species. These effects are summarized by tool, species association, and potential effective use in Table 4.1.3.

Bycatch and bycatch mortality reduction strongly and directly affected by the tool are indicated by 'D'. A lesser but still indirect effect is indicated by 'd'. Likewise, strong or less pronounced indirect effects are indicated by 'I' or 'i' , respectively.

4.1.6 General Economic Factors and Effects: Economic Dimensions of the Bycatch Issue

Economic Factors: Incentives and Disincentives to Discard

Incentives and Disincentives to Discard

Before trying to analyze the effectiveness of measures to reduce bycatch it is important to understand the reasons why discarding occurs and why it may become a problem. Fish are discarded for a number of reasons, but the Magnuson-Stevens Act definition of bycatch suggests that the driving forces behind the practices of discarding can be divided into two major categories: economic and regulatory. In this document, non-regulatory discards by recreational fishers is often included with economic discards and referred to as "*NON-REGULATORY DISCARD*."

The process of discarding is often an economic activity associated with other commercial fishing activities (Pascoe 1997). There is an economic incentive to discard those fish for which the price received does not compensate the vessel operator for the costs involved in their catching, handling and sending to market (Pascoe 1997). From a production perspective, unintended catches and discards are simply an input to the production of fish that are retained and marketed. In short, it is often a business decision to discard. Fish may have a low market value or be completely non-marketable for

Table 4.1.1 Direct effect of tool on regulatory and non-regulatory bycatch, habitat, and monitoring, and rationale for the effect.

	Effect				
	Reduce Regulatory Bycatch	*Reduce Non-regulatory Bycatch*	*Reduce Bycatch Mortality*	*Reduce Habitat Impacts*	*Increase Accountability*
Harvest Levels					
ABC/OY	Low OYs often require management measures such as low cumulative landing limits under some alternatives that made lead to discard. On the other hand, higher OYs may result in higher levels of effort and catch. Depending on alternatives, higher discard may also result.	Many species limited by markets do not reach OY limits, due to the market limit and other constraints placed on fishery by overfished species OYs.	If OY's are reduced, regulatory bycatch mortality may increase for some species if trip limits are reduced. If overall effort is reduced due to restrictions, overall bycatch and bycatch mortality may be reduced.	Lower OY's should reduce fishing effort. Reducing effort should result in reduced habitat impacts.	Lower OYs required for rebuilding of some species may make it difficult to accurately track total catch under some alternatives.
Sector allocations 1/	Distributed OY may have a postive effect in reducing bycatch. Risk and consequences of encountering a "disaster tow" can be spread out among several boats within the sector.	Early attainment of overfished species within a sector may result in reduced overall effort due to fishery closures. Overall catch of species having primarily non-regulatory bycatch (market limited) may be reduced as a result. Non-regulatory bycatch may be reduced due to lower harvest levels.	Under a given OY, catch is allocated and distributed to fishery sectors in some alternatives. Distributed OY may have a postive effect in reducing bycatch mortality to the degree risk of bycatch can be spread and managed by the sector.		Sector allocations would work best with a robust monitoring program. With increased monitoring, There would be less incentive to discard allocated fish, as it would count against the allocation.
Trip (landing) limits 2/	If landing limit increases, bycatch is reduced. Studies have shown that as trip limits decline or cumulative limits are approached, bycatch increases. As cumulative limits are reached, there are stronger incentives to keep higher valued fish and discard species that are close to the limit in order to continue fishing for species having more cumulative limit remaining.	Economic factors such as price, demand, and minimum fish size needed for processing often determine market limits on the amount of fish landed. These factors can lead to discarding of fish after a market limit is reached.	If bycatch is reduced due to increased landing limit, bycatch morality is also reduced. If limits are increased due to larger OYs, bycatch and bycatch mortality may increase due to higher harvest levels.		If landing limits increase, regulatory induced discard is reduced. Reducing discard increases accuracy of estimating total catch at lower levels of fishery monitoring.
Catch limits	Vessel catch limits reduce bycatch when fishing ceases and/or there is a retention requirement. Effect is enhanced when limit is on individual boat, when applied to all groundfish, and monitoring is robust.	If all groundfish catch is retained (Alternative 6), vessel catch limit will have no market induced bycatch, although discards (disposal) on land would increase.	Vessel catch limits should reduce bycatch mortality as there is less need to compete to catch fish (no derby fishery). Same pattern of effect as with regulatory bycatch.	Vessel catch limits may reduce hours trawled through incentives and efficencies to maintain strict catch caps under some options. Reducing trawl hours should reduce habitat impacts.	Catch limits may provide more flexibility by relaxing or eliminating landing limits and reducing discarded catch of those species that are not market limited. Thus, accountability is improved, if full retention is required and/or observer coverage is significantly increased.

Table 4.1.1 (continued). Effect of tool on regulatory and non-regulatory bycatch, habitat, and monitoring, and rationale for the effect.

	Effect				
	Reduce Regulatory Bycatch	*Reduce Non-regulatory Bycatch*	*Reduce Bycatch Mortality*	*Reduce Habitat Impacts*	*Increase Accountability*
Gear Regulations 4/	Regulatory induced bycatch may be reduced by allowing modified gear or alternative gear types that are more selective for non-overfished species and less selective for overfished species.	Allowing modified or alternative gears that are more selective for marketable species may reduce market induced bycatch. Gear changes to select against overfished species may interact with market induced bycatch both positively and negatively.	Making gears less efficient or more selective may result in some species or sizes being avoided, thus reducing bycatch mortality.	Gear modifications may reduce impacts to habitat. Smaller roller gear requires fishers to avoid high relief habitat. Other alternatives allow use of fixed gear to take unused portions of OY. In the latter case, habitat interactions are different, but likely reduced.	Flexible gear regulations may permit experimentation, and use of alternative and more selective gears to access unused portion of OY. Coupled with observers, species selective gears should reduce discarded fish and improve accountability.
Time/area restrictions 5/	Time/area closures eliminate regulatory bycatch within the closed area by eliminating fishing effort. Unless effort is reduced outside the closed area, regulatory bycatch could increase outside the closure.	Time/area closures eliminates non-regulatory bycatch within the closed area by eliminating fishing effort. Unless effort is reduced outside the closed area, non-regulatory bycatch could increase outside the closure.	Bycatch mortality would be reduced within the closed area. Bycatch mortality could increase outside of the closed area if fishing effort increases.	Habitat impacts would be reduced or eliminated within closed areas. Habitat impacts could increase outside of closed areas if effort increases outside the closure.	Accountability would be increased through VMS verification of fishing location
Capacity Reduction	Capacity reduction could occur through a buyback program or through sales of IQs. Reduced effort should allow more flexibility in vessel landing limits that would likely reduce regulatory induced bycatch.	If overall effort is reduced as a consequence of capacity reduction, bycatch of species with low or no value would be reduced. Fewer boats may induce buyers to relax market limits (supply and demand response) and effort could increase. Non-marketable or low valued fish would still contribute to bycatch.	Reduced effort should have a positive impact in reducing bycatch mortality. Fewer boats could result in increased hours fished, possibly offsetting positive effects.	Reduced effort should reduce habitat impacts. Fewer boats could result in increased hours fished , possibly offsetting positive effects.	

Table 4.1.1 (continued). Effect of tool on regulatory and non-regulatory bycatch, habitat, and monitoring, and rationale for the effect.

	Effect				
	Reduce Regulatory Bycatch	*Reduce Non-regulatory Bycatch*	*Reduce Bycatch Mortality*	*Reduce Habitat Impacts*	*Increase Accountability*
Data Reporting					
Logbooks					
Observers					Increased observer coverage under some alternatives would increase accountability by ensuring retention, if required, or accurately accounting for discarded fish.
Vessel monitoring system 6/	VMS can directly reduce regulatory bycatch. Compliance with area closures to protect overfished species, for example, would be assured.		VMS can directly reduce regulatory bycatch mortality. Compliance with area closures to protect overfished species, for example, would be assured.		VMS increases accountability by verifying fishing location.
Enforcement					

1/ PFMC, 2003d.
2/ Pikitch, 1988, Methot, 2000.
3/ Larkin, 2003.
4/ Hanna, 2003 and Davis, 2003.
5/ PFMC, 2001.
6/ PFMC, 2003e.

Table 4.1.2 Effects and rationale for the indirect effects of the application of management measures (tools) designed to reduce bycatch and improve accountability.

	Effect			
	Change Abundance	*Change Habitat Availability*	*Change Spatial and Temporal Concentrations of Bycatch*	*Change Socioeconomic Factors*
Harvest Levels				
ABC/OY	Abundance of overfished species should increase as stocks are rebuilt, those a above MSY could be reduced. *Any changes in population abundance and structure may affect forage available for other animals (birds, mammals, etc.).*			
Sector allocations				
Trip (landing) limits 1/	Present trip limit management attempts to maintain ratios of species in some sectors of the multi-species groundfish fishery. Ratio management may reduce discard but might result in long-term changes in abundance of individual species.		Present trip limit management attempts to maintain ratios of species in some sectors of the multi-species grounfish fishery. Ratio management may result in effort shifting, increasing and/or decreasing bycatch of individual species.	
Catch limits			Catch limits provide flexibility and accountability to manage bycatch. Fishers may more effeciently pick fishing times and locations to minimize take of species with small catch or bycatch limits.	
Individual quotas 2/			Similar effect as described above under catch limits, but with more flexibility if IQs can be purchased.	

Table 4.1.2 (continued). Effects and rationale for the indirect effects of the application of management measures (tools) designed to reduce bycatch and improve accountability.

	Effect			
	Change Abundance	*Change Habitat Availability*	*Change Spatial and Temporal Concentrations of Bycatch*	*Change Socioeconomic Factors*
Gear Regulations 3/	Allowing modified or alternatives gears that are less selective for overfished or other groundfish (undersized fish for example) should contribute to increased abundance of target species. If these changes also allow increased selection and catch per unit effort on non-overfished species, abundance of these species could decrease.	Gears modified to reduce bycatch of target species may have different impacts on habitat. The direction of impact is unknown.	Gear restrictions may have a positive impact at reducing regulatory bycatch of overfished species. If effort and target fishing increases on healthier stocks, bycatch of non-overfished species may increase.	Some gear modifications will make fishing gear less efficient, increasing cost per unit of value of catch.
Time/Area Closure 4/	Abundance (biomass) inside area closures should increase through growth. To the degree density dependence occurs, recruitment may be limited inside but increase outside of reserves.	Incentives for fishing outside of closed areas may result in effort shifts. Effort shifting may free up some kinds of habitat from impacts but increase those impacts elsewhere.	Area closures could result in effort shifting. While overfished species bycatch might be reduced, bycatch of market limited species might be increased, depending on alternatives.	
Capacity Reduction	Longer term, capacity reduction, if it results in reduced effort, contributes to a reduction in overall mortality and bycatch mortality which will in turn increase abundance.	Response to capacity reduction would be to reduce habitat interactions with fishing gears. Latent capacity exists even with a 50% reduction in fleet size. Thus, there is the potential for effort increase even though capacity is reduced. This would tend to offset any benefit and gear impacts on habitat could rebound.	Reduced effort should have a positive impact in reducing bycatch mortality. Fewer boats could result in increased hours fished however, offsetting positive effects. Less effort may allow more flexibility in choice of fishing location - reducing spatial or temporal concentrations of bycatch.	

Table 4.1.2 (continued). Effects and rationale for the indirect effects of the application of management measures (tools) designed to reduce bycatch and improve accountability.

	Effect			
	Change Abundance	*Change Habitat Availability*	*Change Spatial and Temporal Concentrations of Bycatch*	*Change Socioeconomic Factors*
Data Reporting				
Logbooks				
Observers	Increased observer coverage may reduce fishing behaviors that lead to regulatory induced discard. This would have a positive indirect effect in reducing bycatch, reducing unaccounted for fishing mortality, and positively influencing abundance. Increased observer coverage should increase the quality of data used in stock assessments. Estimates of abundance should therefore be improved.	Increased observer coverage may provide better information on habitat - especially if observers collect data on bycatch of benthic invertebrate communities.	Increased observer coverage should provide more accurate data on distributional changes in bycatch. If, however increased observer coverage results in vessel owners/operators preessuring observers to falsify data, accuracy of estimates may be compmised.	Increased observer coverage will add to cost of management and fishing operations.
Vessel Monitoring Systems (VMS) 5/		VMS ensures compliance with fishing locations. Habitat protection within closed areas would be enhanced.		VMS add to cost of fishing and management operations. To the degree compliance and catch accounting are improved, future fishing opportunities and economic stability should be preserved.
Enforcement				

1/ Hastie, 2003.
2/ Larkin, 2003.
3/ Hanna, 2003 and Davis, 2003.
4/ PFMC, 2001.
5/ PFMC, 2003e.

Table 4.1.3 Management tools and potential actions using each tool that have potential to reduce bycatch or bycatch mortality, and potential direct and indirect impacts of each action.

				Potential Effective Uses												
	D = Direct effect d = minor direct I = Indirect effect i = minor indirect		Potential bycatch reducing actions:	Reduce catch in excess of vessel limits?	Reduce proportion of overfished species?	Reduce encounters with overfished species?	Reduce fishing in high relief seafloor areas?	Reduce catch proportion of on-bottom species?	Reduce catch proportion of off-bottom species?	Reduce catch proportion of small fish?	Reduce catch of unwanted finfish species?	Reduce potential for "ghost fishing"?	Reduce catch of marine mammals?	Reduce catch of seabirds?	How easily enforced/ monitored?	Compliance Costs (to vessel)
Species associations most impacted				**Overfished**	**Overfished**	**Overfished**	**Overfished rockfish**	**Overfished rockfish and lingcod, some of flatfish**	**Widow rockfish** and **Pacific whiting**, *yellowtail rockfish*	*Flatfish, rockfish, sablefish*	*Halibut, salmon, skates, rays, and sharks*	*Sablefish*				
Type of bycatch most impacted				Regulatory	Regulatory	Regulatory	Regulatory	Regulatory	Regulatory	Non-regulatory	Non-regulatory	Non-regulatory	Regulatory	Regulatory		
		Alternatives														
Harvest Levels																
	ABC/OY	1-6	larger OYs	i	I	d		d	d		i					low
	sector allocations	4		i	I	i		d	d	I	i	I				low
	vessel landing limits	1-4	larger trip limits	d	D	i	I	D	D	I	d				easy	med
	vessel catch limits	5,6	individual species caps	D	D	D	I	D	D	I	D				difficult	high
	individual quotas	5,6		D	D	D		D	D	I	D				difficult	high/low
Gear Restrictions																
Trawl	mesh size	1-6	Increase mesh size	D						D	D				med	high
	footrope diameter/length	1-6	restrict large diameter	D		d	D	D	D						diff/med	high
	net height		lower net height	I	D	D			D		D				diff	high
	codend	1-6	Increase mesh size, restrict overall size	D											med	high
	design: on-bottom or pelagic		require pelagic trawl		D	D	D	D	D		i				med	high
	bycatch reduction devices		require								D					
Line	number of hooks		reduce number	D		d					i	D			dif	low
	hook size	1	increase size/ decrease		d					D	D				dif	low
	line length		reduce length	D		d						D			dif	low
	soak time	1-6	retrieval requirement	I	i	d					i	D			Dif	low
	bycatch reduction devices		require											D		
Pot/trap	number of pots		reduce number	D		d					D	D			med	low
	pot size										i	D			med	med
	escape panel in net/pot	1-6	require								D	D			med	low
	soak time	1-6	retrieval requirement	I	i	d				i	i	D			Dif	low
Time/Area Restrictions																
	seasons	1-6	close sensitive time/area	d	d	d		i	i	d	D		d	d	easy	low
	area closures	1-6	depth based mgt.	d	D	D	D	i	i	d	D	D	D	D	med	high
	depth closures	1-6		d	D	D	I	i	i	D	D	I	d	d	difficult	high
	marine reserves	6	semi-permenant to permanent	d	D	D	D	i	i	d	D	D	D	D		high
Capacity/number of participants				d			I				i				easy	
	permits/licenses/endorsements	2	reduce number	I	I	d	I	I	I	I	i	D			easy	
	IQs	5,6	establish IQ system													
	limited entry	2	no open access	I	I	d					i	D			easy	
Capacity (vessel restrictions)																
	vessel size	1-6		I		N									Easy	high
	engine power			I		N	I				I				med	high
	vessel type			I		N	I								Easy	high

several reasons: they may be of the wrong species, size or sex; they may be damaged (caused by gear, predation in nets or mis-handling, etc.); or they may be incompatible with the rest of catch (e.g., slime, abrasion or rapid spoilage could cause damage to target species) (Clucas 1997).

Within the category of economic discards there are two distinctly different types (Clucas 1997). "Trash fish" sometimes caught in trawling operations are an example of the first type. Such fish are almost invariably of little or no value and therefore typically discarded whenever caught. For example, spiny dogfish sharks caught in commercial bottom trawl nets typically are several times less valuable than other groundfish species. This category of discards also includes marine life generally considered inedible, such as corals and sponges.

The other type of discarding for economic reasons, often called *HIGH GRADING*, is more situation-specific and occurs when certain attributes of a fish (size, sex or physical condition) make it more marketable and therefore more valuable than another. In general, high grading occurs when the price differential between high- and low-valued fish is greater than the cost of discarding and replacing the catch. For example, there is an incentive to high grade if a landing limit forms a binding constraint on the quantity of fish that maybe retained and sold. It is rational in such cases to discard low-valued sizes species in order to fill the landing limit with more valuable fish. The incentive to high grade is enhanced if the cost to catch additional fish is very low. For example, if an operator chooses to high-grade by discarding 25% of his marketable catch, he will end up having to catch 33% more fish than he would have if he did not engage in high-grading. The incentive to high grade may vary from trip to trip and even within a trip, depending on the various catch rates and catch compositions. For some trips, it may not be rational to discard at all if the landing limit is not reached. However, some fishermen may discard part of their catch early during the trip in anticipation of catching more valuable fish later. In other cases, fishermen may chose to store lower valued fish and discard these only when the landing limit is reached.

Related to high grading, commercial fishers may not have a market for all the fish they catch, even when the fish are of sufficient quality. This occurs when processing plants impose "market limits" to prevent market gluts or to match their processing capacity. For example, a processor may have too few or inexperienced filleters to handle larger quantities or certain species. A commercial fisher who catches more than his market limit may high grade if there is a price differential, or may simply dump the entire excess regardless of size or other factors.

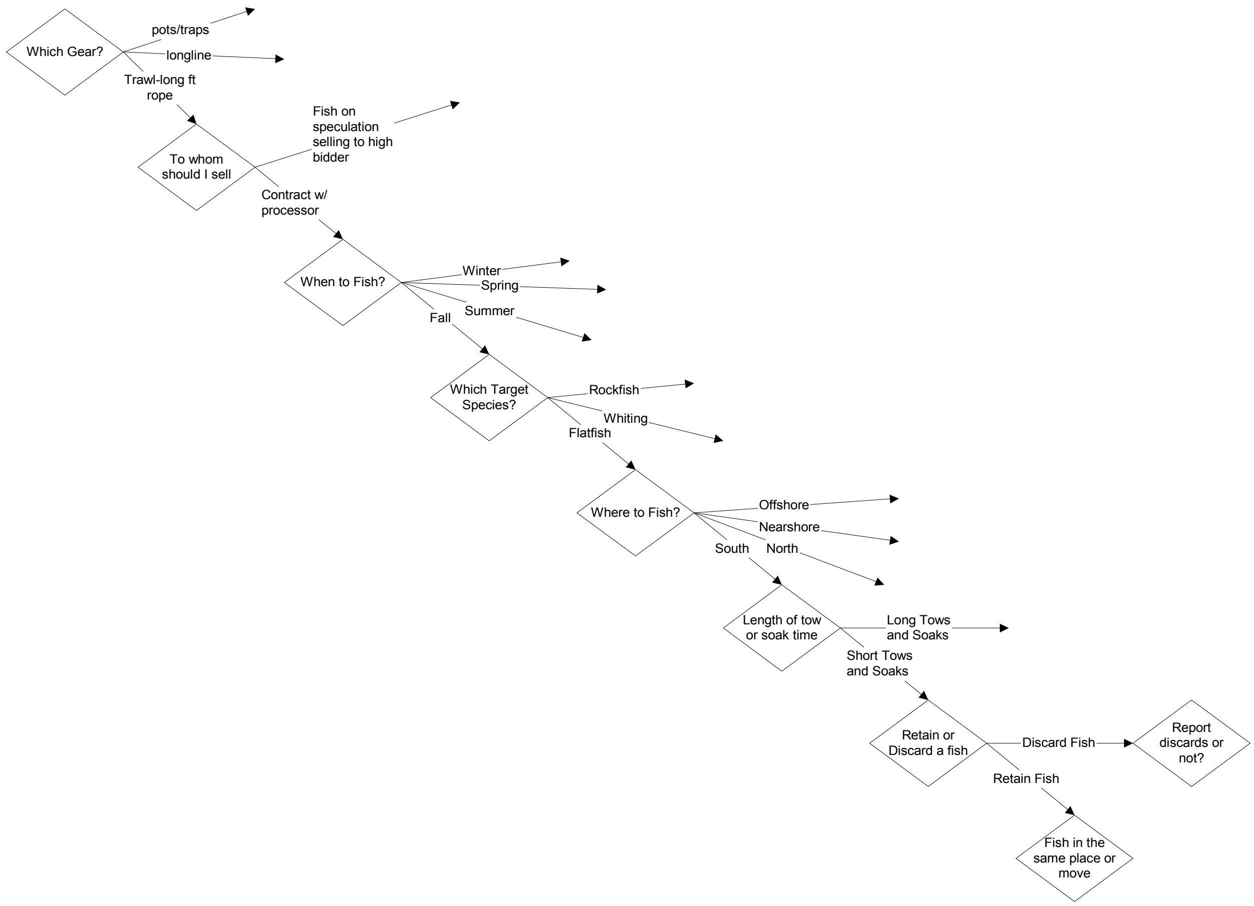
REGULATORY DISCARDS includes fish which, by regulation, fishermen are required to discard whenever caught. Such regulations remove the incentive to target the fish in question by eliminating the economic benefits. For example, it is unlawful for any commercial limited entry vessel to retain any species of salmonid caught with limited entry fishing gear, except in very limited circumstances. Also, State and federal regulations prohibit the landing of Dungeness crab incidentally caught in trawl gear off Washington and Oregon. Regulatory discards also include fish that could otherwise be legally retained and sold but have been caught in a closed season, by a prohibited gear, or in a closed area and therefore must be released or discarded. In addition, regulatory discarding occurs in multi-species fisheries where trip limits or bag limits do not match the actual composition of the catch (Clucas 1997). This means that a commercial vessel or recreational fishery may reach the limit for one particular species while there is still an unfulfilled quota or allowance of other species. As a commercial vessel approaches or has reached its landing limits for one species, there is a strong incentive for the vessel to high grade and discard that species as he continues fishing for other species to fill his remaining species allowances. This is the type of discard most often found in the West Coast groundfish fisheries.

The various incentives and disincentives to discard fish in the West Coast groundfish fisheries under the current management regime can be further clarified by identifying the various decisions that participants in those fisheries face. These decisions include the following:

Decision Point: Which gear should I use when I fish?
Decision Point: When should I fish?
Decision Point: For which species should I fish?
Decision Point: Where do I fish?
Decision Point: How long should I tow, or how much gear should I set?
Decision Point: Should I keep a particular fish or discard it?
Decision Point: Should I fish again in the same place or should I move to a different location?

This series of decision points is depicted graphically in Figure 4.1. Each decision point and the incentives and disincentives are described below in order to gain a better understanding of the behaviors of fish harvesters with respect to bycatch. While most of the discussion focuses on commercial fishing, similar decisions apply to recreational fishers.

Figure 4.1. Harvester decisions regarding bycatch (trawl used as example).



Decision Point: Which gear should I use when I fish? Catch is proportional to the amount of effort applied and the abundance or availability of fish, as modified by the effectiveness of the gear. Thus, all things being equal, the most effective gear would typically be chosen. However, fishers develop preferences and expertise with certain gears, and certain gears are more effective for different species. In addition, regulations place bounds on the types of gear that may be used. The commercial limited entry system largely determines which general gear type any commercial vessel is allowed to use. The limited entry system has produced the positive effect of limiting the amount of groundfish fishing effort (the number of vessels) and limiting the gear a vessel is authorized to use. However, this also reduces the opportunity fora given operator to try different gear types (e.g., switching from trawl to nontrawl gear) that might reduce unwanted catches. For example, there may be methods to selectively harvest abundant rockfish species with hook-and-line gear while having little catch of overfished rockfish species, but trawl gear may not be capable of selectively catching these species. Within the category of trawl gear, however, different configurations and variations can effectively catch flatfish with minimal incidental catch of rockfish. Overall, however, the negative effect of the constraint on changing gears on bycatch is likely to be smaller than the positive impact derived from the limited entry systems restrictions on the amount of gear being used.

Cumulative trip limits have greatly reduced the "race for fish" in all sectors of the groundfish fishery where they have been applied. Because fishers do not have to compete against each other for a share of the fleet-wide harvest quota during any given period, they do not necessarily place themselves at a competitive disadvantage by adopting fishing practices that reduce the catch of unwanted fish. Therefore, vessel operators may be more willing to modify their gears (within the constraints of specified gear regulations) to reduce unwanted catches. For example, a commercial trawl vessel could experiment with a smaller net (shorter footrope), "flatter" net (smaller vertical opening), or use large mesh escape panels. The decision to make these gear adjustments will primarily depend on how they affect the profitability of the fishing operation. Under the current conditions of extremely restrictive trip limits for overfished species such as canary rockfish, however, experimentation may be perceived as having greater risk of hitting a limit.

Decision Point: For which species should I fish (What is my target strategy)?
Successful commercial vessel operators typically may employ a variety of fishing strategies. On an individual trip, the decision about target strategies depends on several factors. The most important is market demand, as identified by the buyers or processors to whom the fish will be delivered. There is typically some formal or informal coordination of targets between the operator and the processor, both before a trip begins and during the trip as fish are caught and identified. Other factors that drive the target strategy are the amounts of unharvested trip limits for various species and the "catchability" of various species in the particular area and time of year the vessel is operating.

Decision Point: When should I fish?
Catch is related to the amount of effort and the abundance (or availability) of fish. Therefore, the time of highest abundance/availability requires the least effort. The current management system has a direct impact on timing decisions. Currently, the commercial fishing year is divided into 6 two-month periods, and trip limits are set for each period. If a vessel does not operate during a period, there is no opportunity to make up that lost revenue. Within each period, fishers have discretion of when to schedule their fishing operations. The Council develops trip limit recommendations for the entire year that take into account seasonality factors. The *GROUNDFISH ADVISORY SUBPANEL* (*GAP*) and *GROUNDFISH MANAGEMENT TEAM* (*GMT*) consult extensively to develop trip limits that will effectively spread harvesting opportunities over the year. The *"BYCATCH" MODEL* uses landings and bycatch data from previous years and anticipated co-occurrence rates by time, depth and area to calculate how much catch would occur under various alternative strategies. In an ideal situation, vessels and processors would focus on a particular species when the species generated the most value for both the processor and harvester, or when the greatest overall value could be achieved (within the constraints of rebuilding plans and overfished species limitations). For example, Dover sole that are aggregated to spawn during winter months can be harvested with relatively little incidental catch of canary rockfish, so the Dover sole trip limits are typically larger at this time. Petrale sole and other flatfish provide similar opportunities. In other cases, the value at that time may be higher depending on consumer preferences. Examples of this are the pre-Easter Lenten season and the Japanese holiday season. By spreading out fishing across the year, cumulative trip limits allow some targeting during these

peak fishing periods. However, this approach is probably less than optimal with respect to avoiding overfished species, maximizing catch of other species, and maximizing total economic values.

Decision Point: Where do I fish?
Catch is related to the amount of effort and the abundance (or availability) of fish. Therefore, the area of highest abundance/availability requires the least effort. The decision of where to fish depends on market demands and the costs of fishing a particular area. In the absence of regulatory constraints on fishing location, the area with the highest perceived potential net revenue will be chosen, which would typically be the area of highest *CATCH PER UNIT OF EFFORT* (*CPUE*) of desirable species and the area nearest home port or market. However, substantial constraints have been applied to reduce the likelihood of catching certain overfished rockfish stocks. Under these conditions, and the fact that cumulative trip limits have eliminated the race for fish, the area with lower probability of encountering overfished species is likely to be chosen, especially if an observer is aboard. In other words, under the current management regime harvesters are likely to take into account bycatch minimization in their decision of where to fish, although they may not necessarily give this factor the same weight as other economic considerations.

Decision Point: How long should I tow? Or, how much gear should I set?
Catch is related to the amount of effort applied and the amount of fish present. Thus, the length of time (or distance) a unit of trawl gear is fished can have a significant effect on bycatch. Likewise, the amount on nontrawl gear used can affect bycatch rates and amounts. Long tows with trawl gear and large sets of fixed gear are more likely to increase the catch of non-target species as well as desirable species. Shorter tows and smaller sets provide the harvester with precise feedback on the type of fish being caught — feedback that cannot be attained with the best electronic sensors. The slower pace of fishing under cumulative trip limits increases the incentive for vessel operators to take the time to check their catch more often. Of course, checking catches more frequently can increase operating costs. Harvesters will weigh the negative effects of catching overfished species or other undesirable species against the additional costs of retrieving gear.

Decision Point: Should I keep a particular fish or discard it? The decision to discard or retain a fish may depend on a number of factors, including the value of the fish, trip limit amounts remaining, the presence of an observer and the likelihood that keeping the fish may affect future earnings. In general, fish caught in the groundfish fisheries can be categorized as follows:

1. Desirable Species - fish (including non-groundfish) that are not overfished, garner a sufficient market price and can be legally landed.
2. Overfished Species - fish from a stock or stock complex that has been determined to be below its minimum stock size (overfished/rebuilding) threshold.
3. Prohibited Species - species or species groups which must be returned to the sea as soon as is practicable with a minimum of injury when caught and brought aboard except when their retention is authorized by other applicable law.
4. Undesirable Species - fish that have no market value.

The decision to discard fish in categories 3 and 4 is straightforward — the law requires prohibited species to be discarded, while there is no economic reason to retain undesirable species. The decision to retain or discard desirable species is primarily a matter of available trip limit amounts. If a vessel's landings of the species in the 2-month period are less than the cumulative trip limit, it is likely the catch will be landed. There may be cases where a vessel high grades fish of a desirable species. For example, larger fish may fetch significantly higher prices than smaller fish. If the price difference is large enough, the operator may be able to generate higher revenue by discarding lower value fish now and incurring the cost of catching additional fish later. The presence of an observer on board is likely to skew the decision toward retention, particularly if there is a possibility that the amount of observer coverage could increase if there is widespread evidence of high grading.

The decision to retain or discard overfished species depends on the specific situation. If the vessel has already landed the full trip limit for that species, the decision to discard is again straightforward. If the operator can land the fish within his or her trip limit and there is an observer on board, the reasonable decision is to retain the fish. Even if an observer is not on board, there are incentives to retain the overfished species: the fish typically has economic value and could increase the total revenue for the trip. In addition, a fisher may believe it is "the right thing to do" for the resource. On the other hand, there may be incentives to discard the overfished species. For example, trip limits for the species could increase (or at least stay the same) if no one else lands the species and catch estimates are skewed downward; if managers believe few of the species have been caught, trip limits for other species may be increased (or not reduced) later in the year, improving the possibility of higher revenues in the long run; the belief that everyone else in the fleet is doing it; and a low probability of being caught doing the "wrong thing" for the resource.

In general, the fleet as a whole is likely to be better off if everyone discards most (but not all) of their overfished species when observers are not present. If all overfished species are discarded when no observers are present, there would be clear evidence that the fleet was under-reporting. However, if all vessels retain small amounts (i.e., amounts under trip limits but less than are actually caught), it may appear as though actual catches are less than they really are, and that could cast doubt on the accuracy of catch estimates of observers. If it appears that catches of an overfished species are reduced, there may be a greater possibility that OYs for cooccurring abundant species will be increased (or reduced less).

Decision Point: Should I fish again in the same place or should I move to a different location?
After the gear is retrieved and the deck is cleared, a final decision faces the vessel operator — should the gear be redeployed in the same area or should the vessel be moved? Again, catch is related to effort and fish abundance/availability. This decision is influenced by the species composition of the last unit of effort, the likelihood that more optimal grounds can be located, and the estimated cost of moving to alternative areas. If there is a possibility that the catch of overfished or prohibited species is less in the alternative location and all other factors are equal, it is likely the vessel will move because cumulative trip limits have effectively eliminated the race for fish. Under an intense race for fish, moving to avoid bycatch is unlikely, as any time not fishing is revenue lost.

Costs of Bycatch

Costs of Bycatch

The economic losses or costs associated with the act of discarding can also be divided into a number of categories. The categories presented below are drawn largely from Clucas (1997) and Pascoe (1997). It is important to note that many of the costs listed are not unique to the problem of discarding — they would occur regardless if the fish are discarded or retained.

For example, the costs associated with fishery interactions would not be eliminated if there were a total ban on discards. Consequently, the problem is more accurately framed as the costs of catching fish that are unwanted (for economic or regulatory reasons) rather than as the costs of discarding per se.

Costs associated with catching, sorting and discarding

a. Costs associated with catching, sorting and throwing the unwanted or prohibited catch over board

Extra costs associated with capture and subsequent discarding include higher fuel consumption in active fishing operations (such as trawling), longer on-deck times for target species while the catch is sorted, leading to a reduction of quality and therefore value of the fish, employment of extra crewmembers required to sort and remove the unwanted catch from the target catch, and greater "wear and tear" on the fishing gear and vessels employed (Clucas 1997). For at-sea processors, lower factory throughput efficiencies and higher processing crew costs may occur due to the additional time required to separate discards from the retained catch. These various costs differ across fisheries and fishing operations. For example, the costs of removing fish from gear may be relatively small for trawl gear, as the fish typically do not need to be physically detached from the gear (Pascoe 1997). Moreover, estimating the economic costs of sorting and discarding fish is difficult due to the problems in determining the opportunity cost of the crew's time (Pascoe 1997). For example, the crew may be otherwise inactive if not sorting the fish.

Foregone catch as a result of juvenile mortalities

b. Foregone catch as a result of mortalities imposed on recruits to the target fisheries

An economic loss also occurs where discard-induced mortalities affect immature individuals or non-legal sexes of the target species (Clucas 1997). The taking of undersized or juvenile fish can produce a number of negative economic effects (Pascoe 1997). Catching undersized fish results in potential *GROWTH OVERFISHING* and *RECRUITMENT OVERFISHING*. With growth overfishing, the juvenile fish could be taken at a later date at a larger, more valuable size. Hence, the overall potential yield of the fishery (and similarly, the value of the yield) is reduced. With recruitment overfishing, the taking of juvenile fish reduces the potential spawning stock size, resulting in lower levels of future recruitment. The lower level of future recruitment can be a direct cost to all participants in the fishery in the form of foregone income (Pascoe 1997).

Discarding over-quota fish (whether as the result of a global quota, individual quota or trip limit) also produces costs (Pascoe 1997). A proportion of these fish could have potentially been caught in the next year, reducing the costs of fishing in order to achieve next year's quota. These costs are again incurred by all fishers in the fishery, including the fisherman who discarded the over-quota catch.

Reducing the potential level of landings can also affect consumers through a reduction in consumer surplus (Pascoe 1997). *CONSUMER SURPLUS* is the area under the demand curve and above the price received. A loss in consumer surplus can occur through a reduced quantity of landings which increases the price to consumers. The loss is related to the responsiveness of price to quantity landed (the price flexibility). If prices are inflexible with respect to quantity landed, then varying the quantity landed will not affect the price received. Consumer surplus in such cases is zero for all levels of landing. However, if prices do respond to the quantity landed, then a reduction in landings will result in an increase in price and a loss of consumer surplus.

Foregone catch taken by other fisheries

c. Foregone catch resulting from mortalities imposed on target fisheries by fisheries targeting other species

A third economic loss occurs when a fishery discards fish of economic importance to another fishery. The result can be an indirect cost to persons involved in the harvesting, processing, marketing or consumption of the species discarded by the target fishery (Pascoe 1997). This fishery interaction situation can be compounded by quota systems which permit individual fishermen to only land specific species (Clucas 1997).

It is important to note that discard mortalities induced by a fishery on species of value to other commercial or recreational fisheries are also often associated with high social costs. For obvious reasons, these sorts of mortalities often spawn bitter conflict between fishery participants and lead to political infighting over resource allocation and bycatch removal quotas (Alverson et al. 1994).

Costs of endangered or threatened species bycatch

d. Costs of endangered or threatened species bycatch

Apart from the negative effects on the fishing industry and fish consumers, bycatch can have a negative effect on others in society who may value the species being discarded and therefore may experience some loss through the death of the animals following discarding (Pascoe 1997). If a bycatch species is severely depleted, threatened or endangered, the cost to society may be especially high. For example, where the species reaches a threatened status, there may be a loss of existence value as there is a possibility that the population may collapse and the species become extinct (consequently, this bycatch is referred to as "critical bycatch" (Hall 1995 cited in Pascoe 1997)). While the value of threatened or endangered species is difficult to measure, an indication of the non-market value of such species can be gauged by the reaction of individuals to their death as a result of any discarding.

Ecosystem and marine food web disruption

e. Disruption of marine food chains and ecosystems

A fifth economic loss may occur when the bycatch of one species has a negative effect on the status of other species through predator, prey, or other biological interactions. These modifications of biological community structures in ecosystems can have indirect effects on fishery resources.

Ecosystem level impacts of bycatch (that is, both the catch and discard components of bycatch) can also negatively affect non-fishery resources. The result of the adverse effects of catch and discard on ecosystems and associated species may be that some members of society experience a loss of existence value and other values derived from the preservation of nature. It is important to note, however, that reduction of either component will not necessarily have a positive impact on marine ecosystems. For example, measures to reduce the discard component in some fisheries would reduce the food supply of scavenging seabirds and could have a severe impact on the ecological balance in wildlife communities (Furness 1999).

Bycatch monitoring costs

f. Bycatch monitoring costs

A sixth stream of costs associated with bycatch is the money that is spent each year on monitoring the level of incidental catches and discards. The main problem facing many fisheries managers is not the fact that discarding takes place per se, but that the level of discarding is not known (Pascoe 1997). Discarded fish represent catches that are not documented in landing statistics, but are nevertheless real removals from the stock (Pascoe 1997). In the case of unrecorded high grading, not only would actual mortality rates be higher than apparent mortality rates, but the age and size distribution of landed catch would be different from the size distribution of the initial harvest (prior to discards) (National Research Council 1999). Without information on discarded catch, it is difficult for fishery managers to calculate the size of a species' population and offer accurate advice toward the conservation of that stock. As a result, attempts to a manage a particular fishery may be based on incorrect assumptions and may allow unwittingly for the overexploitation of that resource. Under precautionary management standards, it is also possible to overestimate the amount of discarded catch, resulting in foregone catch.

Ethical concerns: waste

g. Ethical concerns regarding "waste" in fisheries

From an economic perspective, the discarding of fish is a problem only if it precludes higher valued uses of those or other fish. It is important to note, however, that there may be societal concerns related to the discarding of fish that lie outside the economic-utilitarian paradigm. Specifically, some individuals may consider discarding fish to be wasteful and morally wrong. According to this viewpoint, fish that cannot be used should not be harvested. There are a number of variants of this philosophy. For example, some people may hold the view that nature has rights; to exploit nature is just as wrong as to exploit people (Nash 1989). Other persons may contend that non-human species are intrinsically valuable, independent of any use they may be to humans (Callicott 1986). The latter conviction may be related to religious principles, such as a belief in the sacredness of all or certain life forms. Still other individuals may simply have an undefined sense that uselessly killing life forms is improper behavior and should be avoided.

All of these "moral arguments" are inconsistent with the economic paradigm of trade-offs between money and preservation of species or ecosystems, because they present individuals with the moral imperative that we ought to preserve plants and animals (Stevens et al. 1991). While many of the costs associated with bycatch can be thought of as economic costs and can be quantified, at least in principle, the value that some people assign to eliminating waste in fisheries can not be expressed in monetary terms. These values are presented by their proponents as moral imperatives and, thus, do not lend themselves to analyses of economic tradeoffs. As Costanza et al. (1997) and Pearce and Moran (1994) note, concerns about the preferences of future generations or ideas of intrinsic value translate the valuation of environmental assets into a set of dimensions outside the realm of economics. Nevertheless, these ethical concerns can have economic implications. For example, it can be costly to harvesters and processors if consumers object to the waste and refuse to purchase related products. The importance of product differentiation in some fisheries through labels (such as the "dolphin-safe" labeling of canned tuna, "turtle-safe" labeling of boxes of shrimp, or the publication of "seafood watch" lists judging species abundance levels) is an indication of the economic effect these ethical standards can have (See Roheim (2003) for a discussion of the market impacts of eco-labeling of seafood).

Bycatch Costs as Externalities

Typically, a fisher does not see or pay many "hidden" costs of bycatch

Economic theory says a commercial fisher will continue catching and discarding unwanted fish up to the point at which the costs of this practice begins to have a negative effect on the profitability of his operation. However, under most management programs, an individual fisher does not bear all of all the costs discussed above. In fact, only the costs associated with catching, sorting and throwing the unwanted or prohibited catch over board are fully borne by the individual discarding the fish. While the act of catching juvenile fish affects the potential future benefit to the individual fisherman, it affects all other fishermen in the same fisheries as well. These costs are the product of the combined activities of all participants in the fishery and are therefore outside the control of the individual (Pascoe 1997). The individual vessel operator who chooses to invest in fishing gear and practices that reduce bycatch may be placing himself at a competitive disadvantage if others do not follow suit. The "free-riders" that do not minimize discards will likely increase their relative share of fleet-wide profits.

Nor does the individual fisher fully bear the other bycatch costs described above, if he bears any of them. Rather, the costs of catch and discard are transferred to other members of society as well. These costs are external to fishermen's accounting of costs in that they do not appear in their ledgers and, therefore, are not considered when fishermen calculate whether a particular fishing strategy is profitable. These circumstances, in which certain costs are external to (i.e., do not influence) the fisherman's production decision (Pascoe 1997), result in the individual fisher making inadequate efforts to control bycatch. What this means is that if an individual fisher does not recognize and take account of these *EXTERNAL COSTS*, he will receive signals or incentives that are inconsistent with society's values. That means his decisions will be viewed as wrong decisions from the perspective of society as a whole, and perhaps also from the perspective of the fishermen as a group (NMFS 1996). The result is that the level of bycatch will be higher than the socially optimal level.

Economic theory says that profit-maximizing operations will use an input up to the point that the cost for an additional unit of the input is equal to the revenue that additional unit produces.[4/] Since society has not developed a method to charge the fishing vessel for its use of discarded fish, the profit maximizing vessel operator will treat the unwanted fish as a non-binding constraint in his production. In other words, while the fishing vessel operator treats fish that are eventually discarded as a free good, society places a higher value on those fish, creating conflict between fishers and society.

From an economic perspective, the tendency of the fishing industry to discard fish is not so much a failure of the fishing industry to act responsibly as it is a consequence of the various costs and revenues tradeoffs that businesses make when determining how best to produce the goods that society values. The fact that discards often do not play an explicit role in the profit and loss calculation of fishermen is primarily a failure of society to organize its markets and regulations in a way that charges fishing operations a price that represents the value society places on that resource. This perspective can be used to develop solutions that could lead to changes not only in the way that fishing vessels treat their incidental catch, but also influence their decisions to avoid catching those fish at all.

Impacts to the Physical Environment

4.2 Impacts to The Physical Environment

Changes to the physical environment from bycatch and any bycatch mitigation program are minimal and superficial when compared to the vast expanse of the physical marine environment. The basic geological structure and bathymetry of the seafloor would not be expected to be affected, nor the chemical properties of seawater, current patterns or climate.

Small scale changes to the seafloor surface, including surface sediments, have resulted from groundfish fishing activities in the past and are anticipated to continue under all the alternatives. These changes include movement of rocks, suspension and resettling of sediments, and movement, removal and destruction of corals, sponges and other structure-forming invertebrates. The amount and distribution of previous impacts is largely unknown, and the amount and distribution of future

[4/] For example, as long as each dollar invested makes some profit, it would be a prudent choice to continue increasing one's investment there. When an individual gets back only one dollar for each additional dollar invested, it would be prudent to invest any additional money somewhere else.

impacts is likewise unknown. Currently, NMFS is preparing an EIS for groundfish essential fish habitat that will compile all the available information on bathymetry, sediment distribution, and living structures. That EIS is also expected to identify which habitat features constitute essential habitat and which habitats are vulnerable to fishing operations.

In general, bycatch mitigation alternatives that reduce bycatch of benthic fishes such as corals, sponges and clams will tend to reduce impacts to the physical seafloor. Specific bycatch mitigation tools that reduce these impacts include marine protected areas (MPAs, such as the current Rockfish Conservation Areas (RCAs) and no-take reserves), and tools that restrict or reduce the amount of contact between fishing gears and the seafloor.

Natural and human factors and events affect the coastal marine environment (ecosystem) in a variety of ways. Large and small scale climatic factors sometimes cause dramatic changes in biological productivity, species abundance and biodiversity.

4.3 Impacts to The Biological Environment

Impacts to the Biological Environment

Primary and Secondary Productivity

Primary production (*PHYTOPLANKTON* abundance) and secondary production (zooplankton abundance) influence the abundance of higher trophic level organisms, including fish populations targeted by fishers. None of the alternatives, including the status quo (no action), is expected to impact either phytoplankton or *ZOOPLANKTON* abundance. Similarly, none of the alternatives is expected to impact vegetation, either positively or negatively. Kelp forests off the Washington, Oregon and northern California coasts are not expected to be affected, nor eel grass communities.

From an *ECOSYSTEM* perspective, human fishing activities might be viewed as large-scale predation that consumes species at a variety of trophic levels and may also affect other tropic levels directly or indirectly. Effects of fishing on species abundance, species diversity, community structure and physical environment have been described in numerous studies.
For example, top predators may be removed, resulting in increases of species lower in the food web. At the other trophic extreme, removal of large amounts of krill or other zooplankton can result in reduced productivity and mortality of higher

trophic animals. Fishing practices can also affect habitats, community structure and biodiversity. The cumulative effects of 100 years of West Coast groundfish fishing (and fishing for other species) have helped shape present day ecosystem structure. Forage species (including groundfish and non-groundfish) captured in the course of groundfish fishing may be removed from the environment. Top level predator species may also be removed, resulting in increases of their prey species. Or, their competitors may increase, making it difficult to regain their previous position in the hierarchy. In either case, fishing increases the mortality rate of "unfished" populations. These and other changes could alter trophic dynamics, abundance and biodiversity of the ecosystem. It is difficult, however, to separate many of these fisheries-related changes from environmental ones.

Mitigation tools available to the Council and NMFS can be viewed as falling into three major categories: those that mitigate (reduce) unintended catch, those that may reduce mortality of unintended catch, and those that reduce waste of unintended catch. A fourth category could also be considered (reduce unobserved gear-related mortalities) but very little information is available to address that category. The magnitude of effects for first three categories is difficult to predict, and even the direction of effect may not be apparent or predictable.

Tools to mitigate unintended catch are likely to affect species abundance and ecosystem structure. Some of these tools have more selective effects and may affect relatively few species of similar size and shape. Others have broad effects on a variety of species and sizes. These effects are analyzed for a set of species that represent various trophic levels and geographic areas within the affected environment.

Impacts of the Alternatives on Groundfish Resources

4.3.1 Impacts of the Alternatives on Groundfish Resources

This section lists, discusses and analyzes the impacts of the six alternatives on groundfish resources. The analytical approach and techniques, including the ranking system, were explained in section 4.1.2.

Outside of environmental influences, fishing mortality accounts for the primary impact on groundfish resources. The Council controls fishing mortality through harvest management in order to attain the OY for each species. This is complicated by the fact that groundfish are caught in a suite of mixed species fisheries that correspond to ecological species groupings and reflect fishing strategies as well as stock condition of individual species components. The amount of groundfish taken results from the interplay between the OY specifications, management measures established for rebuilding some species, allocation among competing uses, and facilitating access to healthy stocks of groundfish.

Overfished species play a central role in the consideration of alternatives. Current stock levels reflect a combination of recent and poor environmental conditions leading to lower levels of recruitment and productivity, effects of management of groundfish in the absence of sufficient stock assessment and life history information, increases in fishing efficiency and effort, and unknown impacts of multi-species fishing strategies where discard has contributed to un-accounted for fishing mortality. Abundance of several groundfish species has declined below the overfishing threshold. Some species, such as canary rockfish and bocaccio are at very low stock levels and co-exist with a wide variety of groundfish species across broad latitudinal and bathymetric ranges. Rebuilding these species requires major constraints on harvests of other healthier stocks of groundfish - reducing overall OYs significantly.

Certain groundfish and non-groundfish species have been selected to represent a range of biological resources having significant and different bycatch issues. The application of different management tools can be tailored to address these issues. In our analysis, we attempt to look at how these tools address regulatory and non-regulatory bycatch for *OVERFISHED SPECIES* and select *EMPHASIS SPECIES* (Table 4.3.1) Characteristics of these two groups follow:

- **Overfished species** are the nine groundfish species (bocaccio, canary rockfish, cowcod, darkblotched rockfish, lingcod, Pacific whiting, Pacific ocean perch, widow rockfish, and yelloweye rockfish that have fallen below 25% of spawning biomass levels and have or soon will have rebuilding plans. Most of these species are long-lived rockfish that prefer rocky habitats and have behaviors that may concentrate them in time and space. In addition, rockfish have generally high market acceptance and in many cases high value. These characteristics have made them vulnerable to target fishing, contributing to their present overfished state. Rockfishes are subject to *BAROTRAUMA* and typically do not survive capture. Much of the recent discard of rockfish has been regulatory due to fishers reaching trip limits. Dispersion of these species can be fairly broad and in lower concentrations than preferred habitats, making them vulnerable to capture as incidental catch in fisheries targeting other species. Tools that require retention of overfished species, increase trip limit size, or provide refuge areas tend to reduce bycatch of overfished species.

- **Emphasis species** include 11 species of groundfish from a broad range of habitats. While not overfished, some species are under precautionary management. Others are healthy but their catches are constrained by measures to limit the take of overfished or other species. Flatfishes as a group are also represented. They have a broad dispersion and several do not have significant regulatory bycatch issues. Bycatch in the form of economic discard for this group is often related to size and other market related restrictions. Tools that increase trip limit size for emphasis species constrained by trip limits, require retention, or eliminate the take of undersized fish tend to reduce bycatch of emphasis species.

The analytical methods are intended to reveal the effect of each tool in isolation from other tools, and in combination with other tools grouped together to form a distinct alternative.

Impacts of alternatives on groundfish resources are evaluated in a building block fashion with a special focus on overfished species as these tend to constrain healthier stocks of groundfish. Species under precautionary management, and those above target biomass levels will also be addressed in context with each environmental division and relationship to overfished species.

This EIS addresses the following interactions:
- Catch and bycatch - (direct effects)
- Predatory/prey interactions (indirect effects)
- Fishing strategy interactions (indirect effects)

The analysis of six alternatives is done within an ecological and biogeographical framework as opposed to an individual species by species analysis of impacts. Direct and indirect effects of alternatives will reference keystone species, such as those under a rebuilding plan, other emphasis species of groundfish at or above MSY, and for other non-groundfish species. For purposes of this analysis we have identified the following ecological and biological groupings:

- **Northern Shelf Environment**
- **Southern Shelf Environment**
- **Slope Environment**
- **Pelagic Environment**
- **Nearshore Environment**

Analysis of overfished and emphasis species also reflects important latitudinal differences associated with species distributions along the coast (e.g. north and south of 40° 10' N. Lat.).

Impacts to groundfish are ranked by alternative and summarized in Tables 4.3.1 through 4.3.6.

4.3.1.1 Impacts of Alternative 1 (Status quo/ No Action)

Summary The bycatch policy goal of Alternative 1 is to reduce bycatch of groundfish species by continuing fishery management as provided by the FMP and current groundfish implementing regulations. Relevant Council objectives include maintaining a year-round groundfish fishery, preventing overfishing, rebuilding overfished stocks, and not reducing fleet size below current levels. Bycatch and bycatch mortality are minimized by limiting the number of commercial fishing vessels, restricting gear efficiency and usage, seasons and area management, including marine protected areas. Trip limits (which are based on previous years' observations of the encounter and discard rates of various groundfish species and fishing strategies), are used to discourage fishing in certain times and areas. Gear restrictions are used where possible to reduce potential bycatch rates. Marine protected areas (RCAs) are also used to reduce or prohibit fishing in areas of the continental shelf where certain overfished groundfish species are more likely to be caught. Management relies on catch monitoring and reporting through commercial landings receipts ("fish tickets"), trawl vessel logbooks, port sampling, and observer coverage of a fraction of the groundfish fleet.

Tools Used The following mix of management measures are applied to create Alternative 1. Tool ranks for Alternative 1 are summarized in Table 4.3.1.

Table 4.3.1 Alternative 1: Status quo management. Relative rank of tools used to reduce bycatch and bycatch mortality. Overfished species in **bold** and emphasis species in *italic*. Species below MSY and subject to precautionary management are noted with (p).

Environment	Species	ABC/OY	Performance standard and OY reserves	Trip limits	Catch limits	Retention requirement	Gear restrictions	Capacity reduction	Time/area management	Monitoring program
			None	Yes	Soft sector scorecard	Pacific whiting EFP	Yes	None	RCAs	10% Observer coverage
Northern Shelf	**Canary rockfish**	1	3	4	4	2	2	3	3	5
	Lingcod	1	3	4	4	2	2	3	3	5
	Yelloweye rockfish	1	3	4	4	2	2	3	3	5
	Yellowtail rockfish	1	3	4	4	2	2	3	3	5
	Arrowtooth flounder	1	3	4	4	2	2	3	3	5
	English sole	1	3	4	4	2	2	3	3	5
	Petrale sole	1	3	4	4	2	2	3	3	5
Southern Shelf	**Boccacio**	1	3	4	4	2	2	3	3	5
	Cowcod	1	3	4	4	2	2	3	3	5
	Chilipepper	1	3	4	4	2	2	3	3	5
Slope	**Darkblotched rockfish**	1	3	4	4	2	2	3	3	5
	Pacific Ocean Perch	1	3	4	4	2	2	3	3	5
	Dover sole (p)	1	3	4	4	2	2	3	3	5
	Sablefish (p)	1	3	4	4	2	2	3	3	5
	Shortspine thornyhead (p)	1	3	4	4	2	2	3	3	5
	Longspine thornyhead	1	3	4	4	2	2	3	3	5
Pelagic	**Widow rockfish**	1	3	4	4	2	2	3	3	5
	Pacific whiting	1	3	4	4	2	2	3	3	5
Nearshore	*Black rockfish*	1	3	4	4	2	2	3	3	5
	Cabezon	1	3	4	4	2	2	3	3	5
	Scale	1	1 to 3	1 to 4	1 to 4	1 to 2	1 to 3	1 to 3	1 to 3	1 to 5

- **Harvest Levels** Total catch levels (ABCs and OYs) for groundfish are set based on science-based stock assessments. Overfished species OYs are set in accordance with rebuilding plans. Harvest rates of overfished stocks must be lower than those of "healthier" stocks; a larger fraction of an overfished species population must be allowed to grow and reproduce in order for the stock to rebuild in a timely manner. OYs for overfished species are total catch (mortality) limits.[5/] These OYs are used to determine catches of non-overfished groundfish based on expected catch/bycatch ratios. In order to provide opportunities for several fishing strategies, the Council assigns a portion of most overfished species OYs to each of several fishing "sectors." Target species catch levels for each of those fishing strategies are determined with the help of the NMFS "bycatch model." In contrast to some of the alternatives in this PEIS, Alternative 1 applies these as 'soft' caps that are used primarily to keep track of expected catch in each of the various fishery sectors. Trip limits are used to constrain harvests of other (non-overfished) groundfish. This approach results in harvest opportunities for healthy stocks that may be lower than the total catch OYs for those species (and perhaps landed catch OYs also, if landed catch OYs are established). The GMT monitors commercial fishery landings through the PacFIN quota species monitoring (QSM) program. Recreational catches are monitored through RecFIN and State monitoring programs. These catch statistics (inseason estimates) are periodically compared to the soft caps, and the Council recommends in-season adjustments as needed to ensure overall catches do not exceed the OYs. This method of applying this tool is ranked 3 (lowest among the alternatives) on a scale of 1 to 3 in the column titled "Performance Standards and OY Reserves."
- **Vessel trip limits** Trip limits are used to keep catches and bycatch amounts within the specified OYs. Trip limits under Alternative 1 are the smallest (most restrictive) because potential effort (fleet size) is highest and the season is longest compared to Alternatives 2, 3 and 4. Because smaller trip limits correspond to more regulatory bycatch,

[5/] Rebuilding OYs are set below the ABCs; if catches unintentionally exceed OY, future catch may need to be reduced in order to "catch up" to the rebuilding schedule. Catches above ABC are defined as overfishing, which is not authorized except in very limited circumstances.

this tool is ranked 4 (least effective in bycatch reduction among the alternatives) on a scale of 1 - 4.

- **Vessel catch limits** Vessel catch limits are not explicitly used as a tool in this alternative. Therefore this tool is ranked 4 (no effect) on a scale of 1-4.
- **Gear regulations** Gear restrictions are used to reduce the take of undersized fish and overfished species, and to reduce bycatch and bycatch mortality. Mortality and survival rates of fish that escape fishing gear is unknown. Exempted Fishing Permits (EFPs) are issued to provide participating fishers the opportunity to experiment with various gear modifications intended to reduce bycatch and bycatch mortality of overfished species in particular. This tool is ranked 2 (moderate) on a scale of 1 to 3.
- **Time/area management** Extensive use of MPAs is intended to limit fishing in areas and times where overfished species are most likely to be encountered, thus reducing bycatch and bycatch mortality. Large areas of the continental shelf are closed to most directed groundfish fishing; some open access and recreational fishing may still occur within MPA boundaries. This tool effectively reduces bycatch within the MPA but may result in concentrated fishing and higher bycatch of some species outside the area. Although Alternative 1 undoubtedly reduces bycatch in the MPAs, it uses a less-restrictive application of area management (compared to some alternatives). This application is ranked 3 (lowest) on a scale of 1-3.
- **Capacity reduction** Further capacity reduction is not explicitly considered under this alternative. (The 2003 trawl buyback program has reduced the number of trawl permits by roughly 35%, including many top performers. The effects of this are estimated but actual results may differ.) This tool is ranked 3 (no effect) on a scale of 1 - 3.
- **Data reporting, record-keeping, and monitoring** Under Alternative 1, 100% of the at-sea whiting fleet is monitored by onboard observers; shore-based whiting vessels are required to retain all fish brought aboard (as required by an EFP, and soon by regulation) and landings are observed on shore; and approximately 10% of the remaining commercial groundfish fleet is monitored with on-board observers. Commercial landings data and observer data are used to estimate the total catch and catch ratios of overfished species co-occurring with other groundfish. These data are updated annually and used to change forecasts of OYs and trip limit impacts by fishery sector for the annual

specifications process. This application of the tool is ranked 5 (least effective among the alternatives) on a scale of 1-5.

Summary of Impacts on Groundfish Ranking of effects of Alternative 1 on reducing groundfish bycatch, bycatch mortality, and increasing accountability are summarized in Table 4.3.1. Effects are ranked in comparison to the other alternatives. Smaller numbers indicate a greater effect.

Overfished groundfish

A major source of impacts to groundfish resources is regulatory discard of groundfish due to small trip limits. Primary species affected include (1) overfished groundfish and (2) high value groundfish that are constrained by limits on co-occurring overfished species. While current management is consistent rebuilding strategies, a significant fraction of the overall groundfish OY is discarded or not harvested due to constraints on overfished species. Gear restrictions and MPAs are established to minimize fishing where overfished stocks are most at risk of being caught. By limiting fishing in those areas, fisheries outside the MPAs require less restriction because bycatch rates of those species are lower. However, target species catch rates may also be lower, and even low bycatch rates can result in unacceptably high catches of overfished species. The current MPAs (RCAs) have the added benefit of reducing bycatch of Pacific halibut and those benthic organisms that occur within the RCA boundaries. Pelagic trawling still occurs within the boundaries of RCAs, and there is measurable catch and/or bycatch of Pacific whiting, widow rockfish, and yellowtail rockfish.

Experimentation with gear designs and configurations may result in reduced observed bycatch of overfished species. Some level of unobserved bycatch mortality may occur to fish that encounter fishing gear but do not come onboard; the fate of fish excluded from fishing gears is largely unknown, and fish that escape are likely to suffer some level of bycatch mortality.

Emphasis species

Alternative 1 provides fishing opportunities outside the RCAs while conserving overfished groundfish. Cumulative trip limits are set to reflect ratios that protect vulnerable species while allowing harvest of healthier stocks. Ratio management under Alternative 1 tends to result in lower-than-OY catches of some species, and possibly an increased rate of bycatch/discard for other species. The Dover sole, thornyhead, and sablefish (DTS) complex reflects this dilemma. The DTS complex is managed in part to prevent overfishing of shortspine thornyhead. Under current management, Dover sole, sablefish, and shortspine thornyhead discard rates are often high. Catches of longspine thornyhead (and sometimes sablefish) may be below their OYs.

Midwater trawl fisheries continue provide some fishing opportunity within RCA boundaries for the shelf dwelling yellowtail rockfish, a relatively pelagic (off-bottom) species.

Seaward and shoreward of the RCA boundaries, current management measures do not significantly affect economic discard/bycatch (bycatch resulting from discard of undersized fish or fish having low or no present market value).

4.3.1.1.1 Effects of Harvest Levels under Alternative 1

Groundfish harvest limits are established through annual specification[6/] of ABCs and OYs. Measures to protect overfished species constrain access to healthier groundfish stocks. An OY managed as a harvest cap, as it is for overfished species, may limit or mitigate bycatch and bycatch mortality when used in combination with other tools, such as time/area closures. The Council prepares an impact 'scorecard' to track estimated mortalities by species and target strategy. These are pre-season estimates of fishing mortality. Performance of the various fishery sectors is measured against this scorecard during the fishing season using the best estimates of in-season landed catch and anticipated bycatch. No portion of any OYs is held in reserve. Fishery sectors may or may not be further restricted to keep from exceeding these scores. Alternative 1/no action ranks the same as or lower than other alternatives with respect to effective performance standards, use of OY reserve, and application of sector limits. Observer data gathered in-season along with other fishery information such as logbook data are used to update estimated mortalities annually.

<u>Effects on Overfished Groundfish</u> Most of the overfished groundfish species are considered to be primarily continental shelf species. Under the no action alternative, overfished groundfish of the Northern and Southern Shelf Environments

[6/] Beginning with 2005, ABCs and OYs will be set every two years rather than yearly.

are expected to take decades to rebuild.[7/] Measures to reduce capture/bycatch of canary and yelloweye rockfish will constrain catches of other species in the Northern Shelf Environment for many years as these species rebuild. Measures to rebuild canary rockfish, cowcod, and bocaccio will constrain harvest of other groundfish within the Southern Shelf Environment. Lingcod, which is also an overfished shelf species, co-occurs with other overfished and healthier rockfish species. However, the lingcod OY is relatively large (that is, the stock is more nearly rebuilt to its MSY). Thus, it will not be a constraining stock, and lingcod catches are expected to remain well below OY.

Overfished species OYs are "allocated"[8/] among user groups to accommodate incidental catch needs while those groups target healthier groundfish species. Most allocations are 'soft' limits, in the sense that they are pre-season estimates of amounts expected to be caught, and a fishery sector (or target strategy) may not be totally closed if it reaches the expected catch level. Measures may be adjusted to keep catches near the soft allocations. Flexibility to adjust scorecard amounts is allowed if overall catches are projected to be below the OYs.

Previous analyses for rebuilding plans and annual specifications has demonstrated that fisheries impact stocks differently. For example, a higher proportion of some species of fish taken in the recreational fishery are juvenile fish, compared to the commercial fishery. Canary rockfish is an example: a higher proportion of younger fish in the recreational catch results in a higher "per-ton" impact on rebuilding (PFMC 2003b).

Pacific whiting and widow rockfish are overfished pelagic environment species. In past years, widow rockfish OY levels were large enough to allow targeting with midwater trawl gear, and the midwater whiting fleet took a large proportion of the annual catch. Widow rockfish trip limits were structured to allow a significant portion of the OY to be taken in this way. OYs set to rebuild widow rockfish will be much lower than catch levels of the past decade, which means near future catches of widow rockfish will be far below recent years. In order to

[7/] Rebuilding periods are set less than T_{max} with a probability greater than 60%.

[8/] These are typically not allocations in a formal sense, but rather reflect the distribution of catch that results for the combination of management tools in effect.

keep catches to those limits, it may become necessary to constrain the whiting fishery.

Effects on Emphasis Species[9/] Emphasis species include abundant and important shelf groundfish such as yellowtail rockfish, chilipepper, and shelf flatfishes (such as arrowtooth flounder, petrale sole, and English sole). Important slope complex species include Dover sole, shortspine and longspine thornyhead, and sablefish (the 'DTS' complex).

Unless bycatch avoidance methods are developed, catches and landings of some groundfish species in the near future will be well below their OYs because fisheries are constrained to protect overfished species and species under precautionary management. These constraints have a significant and direct impact on fishing opportunities. Yellowtail rockfish catches are substantially below OY due to measures to reduce catch of canary rockfish and bocaccio. Harvest of the Dover sole, thornyhead, and trawl-caught sablefish (DTS) complex on the continental slope is constrained to prevent overfishing of shortspine thornyhead. DTS trip limits based on expected catch ratios of these species allow access to healthier Dover sole and longspine thornyhead stocks (see discussion on trip limits below). Ratio management may lead to regulatory discard of sablefish and shortspine thornyhead as fishers pursue attainment of Dover sole and longspine thornyhead OYs. Current catches of Dover sole and sablefish are their OYs. Shortspine thornyhead landings are typically near OY, while longspine thornyhead landings are well below OY. Undersized and lower priced sablefish may be discarded in favor of larger more valuable fish– a practice known as "high-grading." .

In other cases, OY is underachieved due to existing market limits that are not linked to regulatory limits. For example, landings of English sole and chilipepper rockfish typically are well below their ABCs. Some level of bycatch and bycatch mortality is likely to occur for both of these species. Forgone catch may indirectly reduce bycatch and bycatch mortality, if

[9/] The term "emphasis species" is used in this EIS to designate non-overfished groundfish species that are particularly important to commercial, recreational and/or Tribal groundfish fishers. They are species for which information is available to support at least qualitative analysis of environmental impacts, and used as indicators of effects on the broader groundfish resource.

OYs for overfished species result in reduced catch of other groundfish.

4.3.1.1.2 Effects of Trip Limits under Alternative 1

Trip limits for the trawl and other commercial fisheries are published each year in the Federal Register (for example, see NMFS, 2003). Trip limits are designed to slow landings rates to maintain a year-round season and to provide incidental catch allowances for overfished species caught with co-occurring groundfish. Some trip limits for overfished species are very small to discourage any targeting. Most contemporary trip limits are cumulative 2 month period limits. Cumulative limits have the effect of minimizing regulatory bycatch/discard of groundfish (catches in excess of the limit) until the last trip of the period.

Recent analysis of 2002 observer data suggests that significant bycatch occurs in the form of regulatory and non-regulatory discard, even when cumulative trip limits are based on ratios of anticipated bycatch (PFMC 2003d). Smaller trip limits are associated with higher bycatch/ discard rates (see discussion of Pikitch *et al* 1988, below). Alternative 1 has the smallest trip limits of the alternatives because the fleet is the largest and the season is longest. The application of trip limits in Alternative 1 is ranked 4 (not very effective) on a scale of 1 - 4 as a tool to reduce bycatch and bycatch mortality for most species, compared to other alternatives that do not rely on retention limits.

<u>Effects on Overfished Groundfish</u>

Over time, trip limits have been modified to better match species associations and relative abundances as reflected in landed catches. Improved knowledge and understanding of depth distributions and associations has provided the basis for trip limits for sub-groups of co-occurring species. For example, trip limits were created for rockfish within the larger *Sebastes* complex to discourage targeting on overfished species. Species assemblages in nearshore, shelf and slope environments are managed more discretely than in past years. (See Table 2.1-12 of the 2003 Groundfish Annual SEIS (PFMC 2003b)). A high percentage of OY for the subgroup left unharvested. Yellowtail rockfish is an example of a shelf rockfish species with a harvest well below OY due to recent trip limit constraints applied to shelf rockfish in order to protect canary rockfish (currently, area closures have the same consequence).

In 2000, reduced trip limits for shelf rockfish were coupled with restrictions on the size of trawl roller gear that could be used on the continental shelf. A study by Hannah (2003, In Press) showed that reductions in trip limits prior to 2000 already began reducing fishing effort in areas of 'prime trawlable rockfish habitat'. The same study also demonstrated that fishing continued adjacent to the harder bottomed, high relief, rockfish habitat areas. However, OY reductions in 2003 and application of species catch ratios resulted in to more restrictive management in 2003.

Trawl logbook and observer data are used to project expected catch ratios of overfished species to other target groundfish species. Individual trip limits are adjusted to keep overfished species OY from being exceeded. If actual ratios of overfished species to target species differ from estimated levels, regulatory bycatch and bycatch mortality are likely to result. If the actual proportion of overfished species is higher than expected, overfished species may be discarded. On the other hand, if the actual proportion of overfished species is lower than expected, target species may be discarded. However, in either case the rates are likely lower than those of past years because the NMFS observer program has provided improved bycatch data.

In a study of West Coast groundfish, discard rates were found to vary inversely with the size of the trawl trip limits imposed (Pikitch *et al.* 1988). Trip limits under Alternative 1, which are likely smaller than all the alternatives, may therefore result in a higher catch and bycatch mortality of overfished species compared to alternatives that allow larger trip limits, or alternatives that utilize a different set of management tools. Vessel trip limits for overfished species are very restrictive under current effort levels and OYs, and are designed to provide for non-target incidental catch, although some target fishing is allowed for lingcod. Generally, restrictive landing limits can lead to higher regulatory bycatch and bycatch. Cumulative 1 or 2 month limits are used to help minimize discard. Under Alternative 1, regulatory discard/bycatch of overfished species would be higher in comparison with other alternatives which use other approaches to maintain catch within OY, encourage landing of more of the catch, or avoid take of overfished groundfish.

Effects on Emphasis Species

As noted in the preceding section, regulatory discard/bycatch may be high if trip limits to protect a weak stock constrain the retention of more abundant co-occurring species. Much of the success using ratios to manage trip limits depends on the how well ratios reflect actual catch proportions. In addition, the target 'mixture' sought by fishers is sensitive to prices of various components of the catch. Currently, catch ratios are applied to the DTS complex to prevent overfishing of shortspine thornyhead. While the Dover sole harvest is usually near the OY, significant fractions of the longspine thornyhead and sablefish OYs may be left unharvested. Previous discard rates for Dover sole are thought to be related to undersized fish and are estimated to be 5% (Sampson and Wood 2002). Recent analysis of the 2002 observer data show that Dover sole discard/bycatch may be a high as 17% (PFMC 2003d). However, the discard/bycatch rate of shortspine thornyhead is estimated to average 30%, and there is some evidence that sablefish discard/bycatch rates may be as high as 40%. This suggests that catch ratios may not be accurate, that high-grading may be occurring, or that ratio application does not take into account the degree of variability that occurs under actual fishing practices. Discard of small sablefish may be the result of high grading (i.e., economic discard/bycatch) because fishers receive a higher price per pound for larger fish, and the most recent assessment suggests a strong incoming year-class (and therefore a higher proportion of small fish in the population).

While regulatory discard of species such as English sole and other shelf and nearshore flatfish species may be low or absent, there may be economic reasons to discard. Trip limits for English sole are liberal under current effort levels and OY, and few vessels attain the trip limits. Market limits set by processors/buyers may result in economic discard/bycatch of large English sole. Undersized English sole are also a major component of discarded catch (See **Gear restrictions**, below).

With respect to the limited entry fixed gear (non-trawl) sablefish fishery, a permit stacking and cumulative limit program provides many of the effects of an individual quota program, including an extended season. In the past, the primary nontrawl sablefish fishery was managed as a competitive derby rather than as a year-round season. Trip limits were used to restrict fishing that occurred outside the primary season. The current program assigns eligible vessels/permits to one of three "tiers" that assures access to a set amount of sablefish. This program may reduce the need to discard fish compared to other sectors without IQs, as fishers have more time to move to areas with higher concentrations of marketable fish. However, it also provides more opportunity for vessels to high grade, keeping only larger, more valuable sablefish. A substantial fraction of sablefish that are caught and carefully released survive (see discussion of handling in the following section on **Gear restrictions**).

4.3.1.1.3 Effects of Catch Limits under Alternative 1

Vessel catch limits are not explicitly used as a tool in this alternative. Therefore this tool is ranked 4 (no effect) on a scale of 1 - 4.

4.3.1.1.4 Effects of Gear Restrictions under Alternative 1

The groundfish FMP and implementing regulations specify and describe gears that may legally be used by commercial and recreational fishers to fish for groundfish. Gear restrictions are specified to modify the selectivity and placement of fishing gears. Some restrictions, such as the minimum mesh size in trawl nets, are intended to minimize bycatch of small fish (juveniles, undersized target species, small species of fish with little market value, etc.); larger mesh allows more fish to escape. Smaller (3 inch) mesh is allowed in midwater trawls that seldom contacts the bottom. Restrictions on the maximum diameter of footropes used with trawl nets, coupled with depth restrictions, reduces the effectiveness of trawl gear in rocky areas of the continental shelf seafloor; this restriction eliminates the use of roller gear that is used to prevent the gear from snagging on rocks and other seafloor structures where rockfish congregate. These and other gear restrictions under Alternative 1 reduce capture/ bycatch of groundfish. This general application of the gear restriction tool is ranked 2 (moderately effective) on a scale of 1 - 3.

<u>Effects on Overfished Groundfish</u> Gear restrictions, modifications, and deployment practices can reduce bycatch and bycatch mortality of overfished species. The minimum legal size of trawl mesh in bottom groundfish trawls is set at 4½ inches to allow escapement of juvenile rockfish, small flatfish, and other small fish. Survival rates of fish that escape through the webbing are not known, however. Species such as lingcod that lack of a swim bladder are more likely to survive than rockfish, when caught with trawl gear. To protect overfished rockfish, the Council initially recommended very small trip

limits for vessels using large footrope trawl gear ("roller gear") on the continental shelf. Larger trip limits were established for trawl vessels fishing primarily for flatfish with small diameter footrope gear. A study by Hannah (2003) demonstrated that trawlers avoided rocky reef areas on the shelf as a result of the regulation, and that encounter rates of rockfish species were reduced. However, the Council and NMFS further restricted fishing to reduce the likelihood that overfished shelf rockfish would be encountered by establishing large marine protected areas (referred to as Rockfish Conservation Areas or RCAs). This was necessary because even rare encounters with canary rockfish, yelloweye rockfish, and bocaccio could result in catches greater than the specified OYs. Gear restrictions outside these protected areas allow for targeting non-overfished species while maintaining relatively low bycatch rates. These measures have a direct effect of eliminating bycatch and bycatch mortality of all species, including overfished groundfish, inside the RCAs. However, increased fishing effort outside the RCAs creates challenges to keeping catches below overfished species OYs, even when encounter rates outside the RCAs remain very low. Geographic shifts in fishing effort outside of the RCA boundaries can also have a direct impact, increasing (or decreasing) bycatch and bycatch mortalities.

The States of Washington, Oregon, and California have recently required the use of fish excluder devices in shrimp trawl nets to reduce rockfish bycatch in that fishery. With use of fish excluders, the catch of rockfish and bycatch mortality in the shrimp trawl fishery should be lower in comparison with nets that do not use these devices, even though survival rates of fish excluded by these devices are largely unknown (Davis and Ryer 2003). Few fish caught in trawls without excluder devices can escape through the small meshes used in shrimp trawls, so most fish would be discarded when brought to the surface. Video observation of fish excluders has shown that many fish actively seek and find exits or are passively excluded from shrimp trawls, while the net is at fishing depth. Escaping rockfish avoid barotrauma associated with being brought to the surface and discarded. Studies have shown that time on deck (Parker *et al.* 2003) and temperature gradient (Davis and Ryer 2003) are important factors in survival of fishes without swim bladders, such as lingcod and sablefish. While these species may be more likely to survive when released at the surface, trauma inducing factors is avoided altogether when fish excluders are effective (Hannah 2003b). Some delayed morality may occur however. Laboratory studies have shown that direct mortality can still occur and behavioral impairment can cause additional delayed mortality (Davis and Ryer 2003). Under *status quo*, state requirements for excluder gear would have a positive and direct impact, reducing bycatch over gears that did not use these devices. Excluders and the selectivity effects of mesh size in general are likely to have a direct impact, causing an unquantifiable amount of bycatch mortality that is lower than would occur without these measures.

Catch of overfished species is expected to be very low to non-existent in fixed gear groundfish fisheries. Although 20 mt of lingcod may be taken by fixed gear limited entry fishers, the overall OY is not likely to be attained. Bycatch and bycatch mortality lingcod caught with fixed is related to the minimum size limit of 24 inches and handling effects on fish described above. Little is known about survival rates of fish escaping gear prior to it being brought on board.

<u>Effects on Emphasis Species</u> Gear restrictions, modifications, and deployment practices can reduce bycatch and bycatch mortality of groundfish. The minimum 4½ inch mesh size aids in the escapement of juvenile or small sablefish and flatfish, although enough small fish are retained to contribute to significant size-related discard/bycatch. Sablefish lack a swim bladder and have a relatively high survival rate if quickly and carefully released.

Mesh size studies have shown that discard of undersized English sole may make up more than 50% of the catch in numbers (TenEyck and Demory 1975). Nearly all of the males and approximately 19% of the females were discarded. English sole have a prominent anal fin spine that has a tendency to catch on trawl meshes. The most recent English sole stock assessment used an assume rate of discard/bycatch of 12.4% during the period 1985-1992 (Sampson and Stewart 1993). Rates of survival of escaping fish are not known.

All trawls, including those using small footropes that are effective at fishing flatfish in non-rocky areas, are currently (2003) prohibited within the RCAs to reduce the incidental capture of overfished rockfish species. Trip limits are structured to effectively limit practical use of large footrope gears for deeper water species, seaward of RCAs.

The use fish excluder devices and other state efforts to reduce canary rockfish catch in the shrimp trawl fishery also affect the catch of other groundfish species as well (Hannah *et al.* 1996). Survival rates of excluded fish are not known and there is no estimate of bycatch mortality (see discussion above under Overfished Groundfish). Direct impacts include reduced bycatch, reduced bycatch mortality for some of the fish, and some increased unobserved bycatch mortality of fish interacting with excluder gear.

CDFG, ODFW, and WDFW are currently sponsoring trawl gear experiments, through the use of EFPs, intended to catch healthier groundfish stocks without catching overfished rockfish. Preliminary reports indicate such “cutback” trawl nets effectively catch species that stay very close to the seafloor but allow other species to escape over the top. If these gear trials are successful, trawl gear modifications may allow greater catches of yellowtail rockfish and flatfish, with minimal bycatch of overfished rockfish. Such gear modifications could have a net overall beneficial effect reducing bycatch and bycatch mortality of overfished species.

Gear restrictions or prohibitions are effective at reducing bycatch within the RCAs. Little is known about the fate of fish caught by trawl and fixed gears that manage to escape through meshes or become freed from hooks. Additional gear measures beyond those under Alternative 1 may be needed to reduce bycatch impacts outside of RCAs.

Sablefish caught by hook or pot gear are known to be susceptible to mortality due to sand flea infestation. Studies in Alaska have found this source of mortality to be small and that all sources of discard amounted to only 12% of the total allowable catch (TAC) in the directed fishery (Richardson and O’Connell 2002). Sablefish may be caught and escape from hooks or through meshes of traps. Survival rates of these fish are not known but are likely high. In addition, fixed gear fishers release undersized sablefish contributing to bycatch and bycatch mortality. In 2002, the Council recommended a reduction in size limit from 22 inches to 20 inches to minimize the amount of sablefish regulatory discard. Studies (cited above) indicate that temperature gradient may influence survivability of sablefish. Time of year fish are harvested therefore influences the potential impact of temperature gradients. The individual cumulative tier limits and the extended fixed gear sablefish season may contribute to a reduction in regulatory bycatch and bycatch mortality (see discussion above under **Trip limits**).

However, high grading (economic bycatch) may be more prevalent than in past years.

4.3.1.1.5 Effects of Time/Area Management under Alternative 1

Marine protected areas (MPAs) and seasonal closures effectively reduce bycatch and bycatch mortality within the boundaries of the closed area (or closed period). This effect only applies to those fisheries closed or restricted from fishing during such time/area closures. Outside the MPA boundaries, bycatch and bycatch mortality may increase, if fishing effort shifts to open areas. Unless an MPA is designated as a no-take reserve, some fishing may be allowed depending on the specified restrictions. To the degree the authorized fishing gears and methods selectively avoid catching the species being protected, bycatch and bycatch mortality of those species would be reduced by such MPAs. Reduced bycatch and bycatch mortality of other species in the area would also be expected.

<u>Effects on Overfished Groundfish</u>
The MPA strategy under Alternative 1 is to restrict or eliminate fishing activities (effort) where there is a high encounter rate of overfished species, and to redirect effort outside of the closed area where encounter rates are relatively lower. The specific application of MPAs, called Rockfish Conservation Areas or RCAs under Alternative 1, are based on depth, time of year (seasonality), and gear restriction designed to minimize the likelihood of encountering canary and yelloweye rockfish in the Northern Shelf Environment, and cowcod and bocaccio in the Southern Shelf Environment. Because of the seasonal distributional behavior of rockfish, encounter rates and fishing patterns are monitored and adjustments are made to keep overall harvest within total catch OYs. Some rockfish have a wider distribution than others, or make seasonal movements, which would require the use of larger protected areas.

Canary rockfish are seasonally more abundant shoreward of the current RCAs boundaries, and trip limits are adjusted to reflect this seasonal distribution to minimize encounter rates. Seasonal mobility and aggregating behavior of canary rockfish within and outside of RCAs may affect ratios of incidental catch of this species to other groundfish. Under Alternative 1, adverse changes to ratios may not be accounted for until the end of the fishing season. Bycatch and bycatch mortality may increase as a consequence. Recent changes to the boundaries (depth limits) of the northern RCA are intended to reduce potential encounters with large concentrations of canary rockfish.

The cowcod conservation areas (abbreviated as CCAs) off the coast of southern California are smaller than the southern shelf RCAs. The cowcod protection areas are designed to protect mature fish that have a high site affinity for habitats consisting of rocky reefs with overhangs and sheltering caves. That is, they never move far and are rarely found away from this habitat.

The marine protected areas (RCAs/CCAs) under Alternative 1 effectively eliminate fishing in areas where overfished rockfish are concentrated.

Effects on Emphasis Species

RCAs may concentrate effort both shoreward and seaward of the boundaries. Seaward of the boundaries, catch, bycatch, and bycatch mortality of the DTS complex could increase due to effort shifting.

Several species of groundfish move onto the shelf during certain times of the year. The RCAs may reduce the vulnerability of these other species to harvest, thereby reducing bycatch and bycatch mortality, depending on the timing and application of the RCA.

Fishing for English sole and other shelf and nearshore flatfish with small footrope trawls is allowed in the North Shelf Environment shoreward of 50 or 100 fm (the inner RCA boundary), depending on time of year. The current RCAs restrict access to these flatfish to some degree, although a substantial proportion of the biomass is shoreward of 50 fm.

If effort concentrates shoreward of RCAs, catch, bycatch, and bycatch mortality of these and other shallow species may increase.

4.3.1.1.6 Effects of Capacity Reduction under Alternative 1

Further capacity reduction is not explicitly considered under this alternative. (The 2003 trawl buyback program has reduced the number of trawl permits by roughly 35%, including many top performers. The effects of this are estimated but actual results may differ.) As this tool is not used, it is assigned a rank of 3 (no effect) on a scale of 1 - 3.

4.3.1.1.7 Effects of Data reporting, Record-keeping, and Monitoring under Alternative 1

Monitoring and reporting requirements are essential fishery management tools. Accountability and accuracy of these programs is proportional to the amount of observer coverage and catch verification that can be accomplished. Higher levels of monitoring yield more complete, accurate, and timely estimates of total catch including bycatch. Indirect benefits would include improved stock assessments and tracking of rebuilding plans. Under Alternative 1, 100% of the at-sea whiting fleet is monitored by onboard observers; shore-based whiting vessels are required to retain all fish brought aboard (as required by an EFP, and soon by regulation) and landings are observed on shore; and approximately 10% of the non-whiting commercial groundfish fleet is monitored with on-board observers. Commercial landings data and observer data are used to estimate the total catch and catch ratios of overfished species co-occurring with other groundfish. These data are updated annually and used to change forecasts of OYs and trip limit impacts by fishery sector for the annual specifications process. This application of the tool is ranked 5 (least effective among the alternatives) on a scale of 1 - 5.

The current observer program and a summary of the first year's results are described in Appendix B. An updated report that includes the second year results will be included in the Final PEIS.

4.3.1.2 Impacts of Alternative 2 (Larger trip limits - fleet reduction)

Summary The policy goal of this alternative is to minimize bycatch by reducing harvest capacity (specifically, reducing the number of limited entry trawl vessels) and increasing trip limits, while continuing to manage for year-round fishing and marketing opportunities and minimizing the costs of fishery monitoring. In this alternative, bycatch and bycatch mortality are mitigated in part by reducing effort and restricting gear efficiency.

Tools Used The following mix of management measures are applied to create Alternative 2. Tool ranks for Alternative 2 are summarized in Table 4.3.2.

Table 4.3.2. Alternative 2: Reduce groundfish bycatch by increasing trip limit size (reduce commercial trawl fleet 50% from 2002-2003 level). Relative rank of tools used to reduce bycatch and bycatch mortality. Overfished species in bold and emphasis species in italic. Species below MSY and subject to precautionary management are noted with (p). Shaded areas reflect change in rank due to fisheries or species characteristics that influence scoring and comparison to other alternatives (see Chapter 4 text describing alternative's effect on emphasis species).

Environment	Species	ABC/OY	Performance standard and OY reserves	Trip limits	Catch limits	Retention requirement	Gear restrictions	Capacity reduction	Time/area management	Monitoring program
			None	Larger trip limits	Soft sector scorecard	None	Yes	50% trawl fleet reduction from 2002-2003	RCAs	10% Observer coverage
Northern Shelf	**Canary rockfish**	1	3	2	4	2	2	2	3	4
	Lingcod	1	3	2	4	2	2	2	3	4
	Yelloweye rockfish	1	3	2	4	2	2	2	3	4
	Yellowtail rockfish	1	3	2	4	2	2	2	3	4
	Arrowtooth flounder	1	3	3	4	2	2	2	3	4
	English sole	1	3	3	4	2	2	2	3	4
	Petrale sole	1	3	3	4	2	2	2	3	4
Southern Shelf	**Boccacio**	1	3	2	4	2	2	2	3	4
	Cowcod	1	3	2	4	2	2	2	3	4
	Chilipepper	1	3	3	4	2	2	2	3	4
Slope	**Darkblotched rockfish**	1	3	2	4	2	2	2	3	4
	Pacific Ocean Perch	1	3	2	4	2	2	2	3	4
	Dover sole (p)	1	3	2	4	2	2	2	3	4
	Sablefish (p)	1	3	2	4	2	2	2	3	4
	Shortspine thornyhead (p)	1	3	2	4	2	2	2	3	4
	Longspine thornyhead	1	3	3	4	2	2	2	3	4
Pelagic	**Widow rockfish**	1	3	2	4	2	2	2	3	4
	Pacific whiting	1	3	2	4	2	2	2	3	--
Nearshore	*Black rockfish*	1	3	4	4	2	2	3	3	4
	Cabezon	1	3	4	4	2	2	3	3	4
	Scale	1	1 to 3	1 to 4	1 to 4	1 to 2	1 to 3	1 to 3	1 to 3	1 to 5

- **Harvest Levels** (harvest policy, rebuilding) ABCs and OYs are assumed to be the same as under Alternative 1. Proportionately more catch would be available to each individual vessel remaining in the fleet compared to Alternative 1. Although harvest level specifications can reduce bycatch, this alternative is no more effective than any other alternative. Therefore, this tool is ranked 3 (least effect) on a range of 1-3 (See column titled "Performance Standards and OY Reserves" in Table 4.3.2).
- **Vessel trip limits** Vessel trip limits are used and would increase under this alternative due to a 50% reduction of the trawl sector relative to the 2002-2003 level. Regulatory bycatch/discard of groundfish is inversely proportional to trip limit size; by increasing trip limits, this alternative would reduce bycatch and associated mortality. However, the relationship between trip limit size and bycatch is not directly proportional. That is, if trip limits are doubled, bycatch/discard would not be cut by half because other factors (such as relative abundance) influence catch rates. This tool is ranked 2 to 4 (moderately effective to least effective relative to other alternatives) on a scale of 1- 4, depending on species.
- **Vessel catch limits** Vessel catch limits are not explicitly used as a tool in this alternative. Therefore this tool has no effect and is ranked 4 (no effect) on a scale of 1 - 4.
- **Gear regulations** Gear regulations under this alternative would be the same or similar to those in Alternative 1. It is not anticipated that capacity reduction of this alternative would permit the use of large footrope gear within current RCA boundaries. This tool is ranked 2 (moderately effective) on a scale of 1 - 3.
- **Time/area management** The application of MPAs (RCAs) would be the same as Alternative 1. Large areas of the continental shelf would remain closed to most directed groundfish fishing; some open access and recreational fishing may still occur within MPA boundaries. This tool effectively reduces bycatch within the MPA but may result in concentrated fishing and higher bycatch of some species outside the area. A 50% reduction in fishing effort (from 2002-2003 levels) might allow redefinition of the timing and application of closed areas to provide more opportunities to access other groundfish resources within current RCA boundaries. Although Alternative 2 would undoubtedly reduce bycatch in the MPAs (the same as the no action alternative), it uses a less-restrictive application of area management than some alternatives. This application is

ranked 3 (lowest) on a scale of 1 - 3, the same as Alternatives 1 and 3.

- **Capacity reduction** Catch is related to effort, selectivity and species abundance. Effort must be viewed in terms of "effective effort," or effort that produces an average catch of groundfish per (trawl) hour fished. Trawl fleet reduction that reduces effective effort would allow trip limits to be increased and would increase the efficiency of other bycatch mitigation tools. However, *effective* effort is the causative agent, and the magnitude of net decrease in catch depends on the net decrease in effective effort. Alternative 2 would still have a net benefit compared to Alternative 1. This tool ranks 2 (more effective) on a scale of 1-3.
- **Data reporting, record-keeping, and monitoring.** Catch reporting, record-keeping, and monitoring through the use of observers may improve over Alternative 1. Assuming the number of observer days remains the same, a higher proportion of total trips and catch would be observed due to the reduced fleet size, larger trip limits, and (perhaps) reduced total number of trips. If effort increases, trip limits may have to be reduced, and the level of observer coverage would be similar to Alternative 1. This tool is ranked 4 (low relative to other alternatives) on a scale of 1 - 5.

Summary of Impacts on Groundfish The effects ranking for Alternative 2 for reducing groundfish bycatch, bycatch mortality, and increasing accountability are summarized in Table 4.3.2. Effects are ranked in comparison to the other alternatives. Lower rank numbers indicate a greater effect.

Overfished groundfish This alternative is similar to Alternative 1 in that trip limits, gear restrictions, MPAs, and a relatively low cost sampling program would be used to reduce bycatch. Alternative 2 differs significantly in that trawl effort is reduced 50% relative to previous years and 15% compared to Alternative 1. The primary effect of effort reduction is that trip limit size would be increased. Reduced effort also tends to make other bycatch reduction tools work more efficiently. Studies have shown that regulatory bycatch rates and the size of trip limit are (roughly) inversely proportional. Because overfished species have the smallest trip limits, they would be expected to be most affected by larger trip limits. That is, larger trip limits would reduce bycatch/discard of these species the most. Thus, effects of trip limits on bycatch reduction on overfished species rank higher than for most emphasis groundfish species (see below).

Emphasis species Larger trip limits would reduce regulatory bycatch/discard of some groundfish species more than others. Species that are relatively unconstrained by current trip limits may be largely unaffected. Species such as chilipepper rockfish and many of the flatfishes would be included in this group. Bycatch/discard of these species is more economic than regulatory. Even if trip limits for overfished and other target species were increased, discard of such flatfish and small rockfish species would not change. For high-value target species that are constrained by trip limits, however, bycatch/discard would likely be reduced. That is because a higher proportion of the bycatch/discard is currently due to regulations, and relaxing the regulations would directly reduce discard/bycatch. Species such as longspine thornyhead, sablefish, yellowtail rockfish, and shortspine rockfish certainly fall into this category, and probably Dover sole, other large rockfish, and lingcod. In short, larger trip limits reduce regulatory bycatch more than economic bycatch. In fact, economic bycatch could increase if trip limits resulted in more catch of low value species.

Capacity reduction would have the greatest positive effects on shelf and slope species because most of the trawl effort occurs in those areas. The effects of increasing trip limits and capacity reduction would be less on nearshore groundfish such as black rockfish and cabezon, which are caught principally by the recreational and open access fisheries. (See gray shaded boxes under trip limit and capacity reduction columns in Table 4.3.2).

4.3.1.2.1 Effects of Harvest Levels under Alternative 2

ABCs and OYs are assumed to be the same as under this alternative. Proportionately more catch would be available to each individual vessel remaining in the fleet compared to Alternative 1. Although harvest level specifications can reduce bycatch, this alternative is no more effective than any other alternative. Therefore, this tool is ranked 3 (least effect) on a range of 1 - 3

4.3.1.2.2 Effects of Trip Limits under Alternative 2

Trip limits would increase, especially outside of RCAs, as a consequence of a 50% reduction in effective capacity of the commercial fleet. Effects of increased trip limits described above under General Effects of Fishery Management Tools are likely to be significant compared to *status quo* and are given a rank 2 or 3 on a scale of 1 - 4 scored for other alternatives, depending on the species. (Some alternatives are given a rank of 1 due to elimination of trip limits as a tool.)

<u>Effects on Overfished Groundfish</u> Increased trip limit size may have a direct and positive impact, making possible an increase in per vessel retained catch of overfished groundfish and reducing bycatch associated with regulatory induced discards. In a study of west coast groundfish, discard rates were found to vary inversely with the size of the trawl trip limits imposed (Pikitch *et al.* 1988). All limits of overfished rockfish are low under *status quo* compared to historical levels. Reducing discard by increasing trip limit size would still depend on the appropriate application of RCAs and ratio management. A fine balance would be needed to allow more overfished species to be caught as incidental catch to other target strategies, without creating a trip limit large enough to encourage targeting of the overfished species.

The Council could elect to keep limits lower in an attempt to rebuild overfished species faster. Bycatch and bycatch mortality might be reduced in comparison to the above scenario, due to a reduction in overall harvest opportunity. The smaller limits might offset this reduction due to the effect of smaller trip limits on regulatory induced bycatch.

Effects of increased trip limits result from capacity reduction. The alternative ranks 2 in terms of ability of the trip limit tool to reduce bycatch and bycatch mortality of overfished species.

<u>Effects on Emphasis Species</u> Vessel trip limits could increase outside of RCAs boundaries as a consequence of a 50% reduction in effective capacity of the commercial fleet. Ratio management would allow more access to other groundfish as long as catch of overfished species did not exceed OY. Under status quo, several species of groundfish are harvested well below OY due to constraints on overfished species such as shortspine thornyhead currently under precautionary management. Under *status quo,* for example, there appears to be a lack of attainment of OYs for sablefish and longspine thornyhead at the same time there may be high discard rates of sablefish and shortspine thornyhead. A larger trip limit may help fishers gain access to OY and may reduce discarding.

Increased trip limit size should have little impact on some species that are more limited by markets than regulatory trip limits under status quo. For example, landings of English sole are limited by size and market limits, not trip limit size.

Because increased trip limit size may not result in a change in harvest for many emphasis species due to existing non-regulatory constraints such as undersized fish and market limits, the trip limit tool used in Alternative 2 is ranked 3 on a scale of 1 - 4.

Since it is assumed most of the capacity reduction would apply to the trawl fleet, this tool would have less impact on trip limits for cabezon and black rockfish compared to other species. Cabezon and black rockfish are caught primarily by commercial limited entry or open access hook and line fishers and the recreational fishery. The effectiveness of Alternative 2 trip limits on reducing bycatch and bycatch mortality for nearshore species such as black rockfish and cabezon is ranked 4 (little effect) on a scale of 1 - 4.

4.3.1.2.3 Effects of Catch Limits under Alternative 2

Vessel catch limits are not explicitly used as a tool in this alternative. Therefore this tool is ranked 4 (no effect) on a scale of 1 - 4.

4.3.1.2.4 Effects of Gear Restrictions under Alternative 2

Gear restrictions under this alternative would be the same as under *status quo*. Therefore, the Alternative 2 application of gear tools is ranked the same as for the *status quo*, or 2 on a scale of 1 - 3 (Table 4.3.2).

<u>Effects on Overfished Groundfish</u> It is not anticipated that the level of trawl fleet reduction under this alternative would allow the use of large footrope gear in MPAs or other liberal modifications. The effects on overfished groundfish is the same as Alternative 1.

<u>Effects on Emphasis Species</u> Current regulations prohibit fishing within RCAs by most gear types, including groundfish trawl gears, with the exception of pelagic trawls. A 50% reduction in effort may allow use of small foot rope trawl gears within the RCAs. An analysis of Oregon and Washington trawl logbook data showed that both trip limits and the 8 inch size restriction on trawl roller gear were effective in reducing or

eliminating trawl effort over 'prime trawlable rockfish habitat' (Hannah 2003). Current shelf RCAs have a significant amount of ground still trawlable with small footrope trawl gears. If fishing with these trawls were allowed within RCAs, bycatch and bycatch mortality could increase for both overfished and healthy groundfish stocks.

4.3.1.2.5 Effects of Time/Area Management under Alternative 2

The timing, bathymetric limits, and gear restrictions associated with the current marine protected areas (MPAs/RCAs) would remain the same as under *status quo*. These MPAs and seasonal closures effectively reduce bycatch and bycatch mortality within the boundaries of the closed area (or closed period). This effect only applies to those fisheries closed or restricted from fishing during such time/area closures. Outside the MPA boundaries, bycatch and bycatch mortality may increase, if fishing effort shifts to open areas. Unless an MPA is designated as a no-take reserve, some fishing may be allowed depending on the specified restrictions. To the degree the authorized fishing gears and methods selectively avoid catching the species being protected, bycatch and bycatch mortality of those species would be reduced by such MPAs. Reduced bycatch and bycatch mortality of other species in the area would also be expected. The Alternative 2 application of time/area management is ranked 3 on a scale of 1 - 3, the same as the no action alternative (Alternative 1).

<u>Effects on Overfished Groundfish</u> Same as Alternative 1. The MPA strategy under Alternative 2 would be to restrict or eliminate fishing activities (effort) where there are high encounter rates of overfished species, and to redirect effort outside of the closed areas where encounter rates are relatively lower. The specific application of MPAs are based on depth, time of year (seasonality), and gear restriction designed to minimize the likelihood of encountering canary and yelloweye rockfish in the Northern Shelf Environment, and cowcod and bocaccio in the Southern Shelf Environment. Because of the seasonal distributional behavior of rockfish, encounter rates and fishing patterns would be monitored and adjustments made to keep overall harvest within total catch OYs.

The cowcod conservation areas off the coast of southern California, which are smaller than the southern shelf RCAs, would be continued. The conservation areas are designed to protect mature fish that have a high site affinity for habitats consisting of rocky reefs with overhangs and sheltering caves. That is, they never move far and are rarely found away from this habitat.

The marine protected areas (RCAs/CCAs) under Alternative 2 would effectively eliminate fishing in areas where overfished rockfish are concentrated.

<u>Effects on Emphasis Species</u> Bycatch and bycatch mortality would remain similar to *status quo* levels. The RCAs may concentrate effort both shoreward and seaward of the boundaries. Seaward of the boundaries, catch, bycatch, and bycatch mortality of the DTS complex could increase due to effort shifting.

The RCAs may reduce the vulnerability of several species of groundfish that move onto the shelf during certain times of the year, thereby reducing bycatch and bycatch mortality. Effects would depend on the timing and application of the RCAs.

Fishing for English sole and other shelf and nearshore flatfish with small footrope trawls would be allowed in the North Shelf Environment shoreward of 50 or 100 fm (the inner RCA boundary), depending on time of year. The RCAs would continue to restrict access to these flatfish to some degree, although a substantial proportion of the biomass is shoreward of 50 fm.

If effort concentrates shoreward of RCAs, catch, bycatch, and bycatch mortality of these and other shallow species may increase.

4.3.1.2.6 Effects of Capacity Reduction under Alternative 2

The trawl fleet would be reduced by 50% from 2002-2003 levels. The November 2003 trawl buyback program removed 91 permits from the fleet (about 35%); Alternative 2 would further reduce the fleet by about 15%. Effects of capacity reduction described above under “General Effects of Fishery Management Tools” are likely to be significant compared to *status quo* and other alternatives. The application of capacity reduction in Alternative 2 is ranked 2 or 3 on a scale of 1 - 4, depending on the species.

Effects on Overfished Groundfish Assuming an additional 15% reduction beyond the trawl buyback, a roughly proportionate increase in overfished species trip limit size would be anticipated. Thus, effort reduction would have an indirect impact on reducing bycatch and bycatch mortality.

Effects on Emphasis Species Trip limits for several species of groundfish at or near MSY would increase as a consequence of effort reduction under this alternative. Effort reduction would have an indirect effect on reducing bycatch and bycatch mortality of other groundfish.

The trawl fleet has relatively little impact on nearshore species such as cabezon and black rockfish. Such nearshore species are caught primarily by recreational and commercial hook-and-line fishers. Therefore, further trawl capacity reduction would have little or no effect on reducing bycatch and bycatch mortality for nearshore species such as black rockfish and cabezon

4.3.1.2.7 Effects of Data Reporting, Record-keeping, and Monitoring under Alternative 2

Higher levels of monitoring yield more complete, accurate, and timely estimates of total catch including bycatch. Indirect benefits would include improved stock assessments and tracking of rebuilding plans. Under Alternative 2, 100% of the at-sea whiting fleet would be monitored by onboard observers; shore-based whiting vessels wold continue to be required to retain all fish brought aboard (as required by an EFP, and soon by regulation) and landings would be observed on shore; and approximately 10% of the non-whiting commercial groundfish fleet would be monitored with on-board observers. Commercial landings data and observer data would be used to estimate the total catch and catch ratios of overfished species co-occurring with other groundfish.

Under Alternative 2, catch reporting, record-keeping, and monitoring through the use of observers may improve over Alternative 1. Assuming the number of observer days remains the same, a higher proportion of total trips and catch would be observed due to the reduced fleet size and (perhaps) reduced total number of trips. If effort increases, trip limits may have to be reduced, and the level of observer coverage would be similar to Alternative 1. This tool is ranked 4 (low, relative to Alternatives 4, 5 and 6) on a scale of 1 - 5.

4.3.1.3 Impacts of Alternative 3 (Larger trip limits - shorter season)

Summary The policy goal of Alternative 3 is to minimize bycatch by increasing trip limits and shortening the fishing season by as much as 50%. In this alternative, bycatch and bycatch mortality are controlled in part by modifying effort and gear efficiency. Alternative 3 would reduce each vessels's fishing without reducing fleet size. This alternative supports Council objectives of preventing overfishing, rebuilding overfished stocks and keeping monitoring costs low. It would not maintain year-round groundfish fishing opportunities for individual vessels, but could be designed to maintain some level of groundfish product flow to markets over the entire year. If individual commercial vessel fishing periods were staggered, a year-round supply of fish would be available for some fish buyers and processors.

Tools Used The following mix of management measures are applied to create Alternative 3. Tool ranks are for Alternative 3 summarized in Table 4.3.3.

- **Harvest Levels** (harvest policy, rebuilding) Harvest levels are assumed to be the same as under Alternatives 1 and 2.
- **Vessel trip limits** This alternative assumes the season would be shortened for fishing vessels and that some form of *PLATOONS* would be used to maintain fishing throughout the year. (Platoon systems divide vessels into two or more groups that operate on different schedules.) Vessel trip limits under this alternative are assumed to be the similar to those under Alternative1. If platoons were established, seasons each platoon would be modeled by the GMT to maintain trip limits. Trip limits equivalent to those in Alternative 2 would reduce bycatch and bycatch mortality in a fashion similar to Alternative 2.[10/] However, seasonal patterns would likely be different, and bycatch of some species would likely be different. This tool is ranked 3 (low compared to other alternatives) on a scale of 1-4.

[10/] Because Alternative 2 (capacity reduction) would reduce effort by about 15% from the status quo, fishing time under Alternative 3 would not have to be reduced by 50% to achieve similar trip limits. If fishing time (or seasons) were reduced by 50%, the resulting trip limits would likely be larger than those of Alternative 1, and thus regulatory bycatch reduced more.

Table 4.3.3. Alternative 3: Reduce groundfish bycatch by increasing trip limit size (reduce commercial season). Relative rank of tools used to reduce bycatch and bycatch mortality. Overfished species in **bold** and emphasis species in *italic.* Species below MSY and subject to precautionary management are noted with (p). Shaded areas reflect change in rank due to fisheries or species characteristics that influence scoring and comparison to other alternatives (see Chapter 4 text describing alternative's effect on emphasis species).

Environment	Species	ABC/OY	Performance standard and OY reserves	Trip Limits	Catch limits	Retention requirement	Gear restrictions	Capacity reduction	Time/area management	Monitoring program
			None	Larger trip limits	Soft sector scorecard	None	Yes	None	RCAs and shortened season	10% Observer coverage, 100% logbook coverage, verification
Northern Shelf	**Canary rockfish**	1	3	3	4	2	2	3	3	4
	Lingcod	1	3	3	4	2	2	3	3	4
	Yelloweye rockfish	1	3	3	4	2	2	3	3	4
	Yellowtail rockfish	1	3	3	4	2	2	3	3	4
	Arrowtooth flounder	1	3	3	4	2	2	3	3	4
	English sole	1	3	3	4	2	2	3	3	4
	Petrale sole	1	3	3	4	2	2	3	3	4
Southern Shelf	**Boccacio**	1	3	3	4	2	2	3	3	4
	Cowcod	1	3	3	4	2	2	3	3	4
	Chilipepper	1	3	3	4	2	2	3	3	4
Slope	**Darkblotched rockfish**	1	3	3	4	2	2	3	3	4
	Pacific Ocean Perch	1	3	3	4	2	2	3	3	4
	Dover sole (p)	1	3	3	4	2	2	3	3	4
	Sablefish (p)	1	3	3	4	2	2	3	3	4
	Shortspine thornyhead (p)	1	3	3	4	2	2	3	3	4
	Longspine thornyhead	1	3	3	4	2	2	3	3	4
Pelagic	**Widow rockfish**	1	3	3	4	2	2	3	3	4
	Pacific whiting	1	3	3	4	2	2	3	3	4
Nearshore	*Black rockfish*	1	3	4	4	2	2	3	3	4
	Cabezon	1	3	4	4	2	2	3	3	4
	Scale	1	1 to 3	1 to 4	1 to 4	1 to 2	1 to 3	1 to 3	1 to 3	1 to 5

- **Vessel catch limits** Vessel catch limits are not explicitly used as a tool in this alternative. Therefore, this tool is ranked 4 (no effect) on a scale of 1-4.
- **Gear Regulations** Alternative 3 would maintain the same gear regulations as Alternative 1 and be structured to keep catches within overfished species OYs. It is this alternative would permit the use of large footrope gear within current RCA boundaries, because that would increase the potential for catching overfished rockfish species. However, small footrope gear may be re-introduced into RCAs. This tool is ranked 2 on a scale of 1 - 3, the same as the *status quo*.
- **Time/area management** In addition to the RCAs used in Alternative 1, this alternative compresses the fishery through seasonal closures or other restrictions on fishing time for each commercial vessel. For instance, each platoon would be allowed only 6 months of fishing. This tool is ranked 3 (lowest) on a scale of 1-3 , the same as Alternatives 1 and 2.
- **Capacity reduction** No further capacity reduction is considered under this alternative. This tool is ranked 3 (no effect) on a scale of 1-3.
- **Data reporting, record-keeping, and monitoring** Catch reporting, record-keeping, and the monitoring program would be the same as Alternatives 1 and 2. The compressed season would mean that the percentage of total trips covered by observers would increase over Alternative 1. Each vessel's fishing time would be less than under Alternative 2, and therefore this tool is ranked 3 (moderate improvement) on a scale of 1-5.

Impacts on Groundfish Effects of tools used in Alternative 3 to reduce groundfish bycatch, bycatch mortality, and increasing accountability are ranked and summarized in Table 4.3.3. Effects are ranked by in comparison to the other alternatives. Lower numbers indicate a greater effect.

<u>Overfished groundfish</u> Under Alternative 3, trip limit size would be increased to reduce bycatch and the season would be shortened so that larger trip limits could be maintained. By dividing the commercial fleet into two or more platoons, some level of landings and market flow would be maintained year-round. However, individual vessels would fish groundfish only during a designated portion of the year. Fleet response to this approach is hard to predict, especially if vessels were allowed to choose when they would fish without some pre-registration requirement. (Remember, that the full year's trip limits must be

determined before the beginning of the fishing year, January 1.) The shortened season could result in some fishers choosing alternative non-groundfish fisheries, or electing to fish at a particular time of the year. If increased fishing resulted at a time of year when encounter rates of overfished species is higher, more of those overfished species would be likely to be killed. Subsequent fishing later in the ear would have to be curtailed to compensate for such unexpected occurrences. If fishers were allowed to freely choose in advance which period they would fish, it is likely product flow would be inconsistent or interrupted, because many would choose to fish groundfish when they could not fish for shrimp, crab, albacore or other species. Some level of groundfish bycatch would likely occur during those fisheries, and target trip limits would have to be reduced to compensate. Aside from these concerns, the impacts of a reduced season and larger trip limit size should be similar to Alternative 2, without the costs of further fleet reduction programs.

Emphasis species As was described above under the Alternative 1, bycatch of DTS complex species may be the result of several factors, including size, attainment of regulatory limit, and high grading (for example, sablefish). A 50% reduction in fishing season and increased trip limits would tend to reduce regulatory bycatch/ discard. Larger trip limits for shortspine thornyhead would be expected to reduced bycatch/discard of this species. High grading of sablefish may still occur, however.

Larger trip limits for the “other flatfish” category would have relatively little effect on bycatch because market factors play an important role. Trip limits under the status quo are typically quite liberal and are larger than most vessels’ landings. Bycatch and bycatch mortality are more related to market limitations such as size, price, and quantity. If a primary vessel response to reduced groundfish fishing time is drop out of the fishery (or to spend more time in alternative fisheries rather than to fish harder during their groundfish openings), the overall catch of groundfish target species may be reduced. That would result in reduced bycatch and bycatch mortality of other groundfish as well.

As with Alternative 2, larger trip limits and shorter fishing time would have less effect on nearshore fisheries, unless open access commercial and recreational fishing seasons are also reduced. (See gray shaded box under trip limit column in Table 4.3.3).

4.3.1.3.1 Effects of Alternative 3 Harvest Level Specifications

Objectives for setting optimum yield would remain the same as in Alternatives 1 and 2. Under Alternative 3, fishing periods would be compressed or the season shortened. Other than soft sector allocations similar to *status quo*, there would be no performance standards or OY reserves. Ranking of this tool as used in Alternative 3 would be the same as *status quo*, or 3 on a scale of 1 - 3.

<u>Effects on Overfished Groundfish</u> On a per vessel basis, a shorter season may allow larger shares of OY per trip due to potentially larger trip limits compared to *status quo*, and would have an impact similar to Alternative 2, reducing bycatch and bycatch mortality of overfished species.

<u>Effects on Emphasis Species</u> Objectives for optimum yield would remain the same as in *status quo.* On a per vessel basis, a shorter season may allow larger shares of OY per trip compared to *status quo*. Several species of groundfish at or above MSY are currently under-harvested due to constraints on overfished stocks or market limits. One possible consequence of this alternative is that more OY would go unharvested due to the reduced season.

4.3.1.3.2 Effects of Trip Limits under Alternative 3

Vessel trip limits would initially be the same as those in Alternative 2. The season would be shortened to match the new trip limit. The shortened season would allow access to more of the overall OY for groundfish species. Much would depend on fleet response to a shortened season and larger cumulative limit. Platooning of the fleet would be done to maintain a supply of groundfish year-round. If fishers increase effort to compensate for the reduced season, season length would be reduced to maintain trip limit size. The compressed season anticipated larger trip limits should have a significant impact on reducing bycatch and bycatch mortality compared to *status quo.* Although trip limits should be similar to Alternative 2, the capacity reduction alternative, this alternative ranks lower as it may be difficult to optimize trip limits and season length in such a fashion as to minimize bycatch and bycatch mortality compared to Alternative 2.

Effects on Overfished Groundfish Vessel trip limits would increase, especially outside of RCAs as a consequence of a 50% reduction in the fishing season. The fleet would be platooned into two or three groups with shortened fishing periods. This would create a more even flow of fish and supports the current Council goal of maintaining a year-season. In either case, the larger trip limit sizes would tend to decrease bycatch and bycatch mortality associated with regulatory induced discards. If fishers compensate for the shortened season and larger trip limit by increasing effort, the benefits of a shortened season might not be realized. Too much effort could result in the season being reduced. A shorter season may reduce harvest if some fishers elect not fish during the openings. Bycatch and bycatch mortality would be reduced but product flow may be interrupted.

Effects on Emphasis Species Vessel trip limits would increase, especially outside of RCAs as a consequence of a 50% reduction in the fishing season.

As was described above under the *status quo,* bycatch of species within the DTS may be the result of several factors, including size, attainment of regulatory limit, and high grading related price structure of different sizes of sablefish. A 50% reduction in fishing season and increased trip limits for components of the complex would tend to reduce regulatory induced discard. Within the DTS complex, bycatch of shortspine thornyhead may be reduced if a larger trip limit for this species is allowed. High grading of sablefish may still occur, however.

The potential increase in trip limit size not likely a significant factor for some species of groundfish like those in the other flatfish category. Landing limits under *status quo* are quite liberal compared to current catches and attainment of the cumulative limit under Alternative 3 is not likely. Bycatch and bycatch mortality is related to market limitations related to undersized fish, price, and constraints on quantity. If fleet response to the shortened season is to seek some alternative fishery rather than increase effort during season openings, bycatch and bycatch mortality may be reduced due to a reduction in overall harvest levels.

4.3.1.3.3 Effects of Catch Limits under Alternative 3

Vessel catch limits are not explicitly used as a tool in this alternative. Therefore this tool is ranked 4 (no effect) on a scale of 1 - 4.

4.3.1.3.4 Effects of Gear Regulations under Alternative 3

Gear regulations alternative would be similar to *status quo* and structured to keep catches within the OY limits for overfished species. Gear restrictions are likely to remain the same as under *status quo* in the near future due to rebuilding requirements of overfished species, however. Alternative 3 application of gear tools therefore ranks the same as *status quo*, or 2 on a scale of 1 - 3.

<u>Effects on Overfished Groundfish</u> It is not anticipated that a 50% reduction in fishing season would permit the use of large footrope gear within current RCA boundaries. However, small footrope trawls could be re-introduced into RCAs if overall OYs for overfished species could be maintained. Currently, lingcod and yelloweye catches remain below OY. Lingcod in particular may be harvested at a higher rate if small footrope trawls are reintroduced. Even with more liberal trip limits and new gear options, canary rockfish catch is very close to OY, thus would constrain access to fishing within the RCAs. Thus, bycatch and bycatch mortality within RCAs could increase over *status quo,* if management measures similar to those used in 2000-2002 were employed within the RCAs. Current canary rockfish, therefore may preclude use of small roller gear within the RCAs. A similar circumstance exists for the southern shelf area - bocaccio catch under *status quo* is very close to OY.

<u>Effects on Emphasis Species</u> Larger trip limits stemming from a shorter season may allow access to species of groundfish within the RCA that are precluded from harvest under *status quo.* Harvest levels for several species of shelf groundfish are below current OY levels. Use of small footrope gear could allow more access to Dover, English and petrale soles found on the shelf. Unfortunately, canary rockfish and bocaccio catches under *status quo* are very close to OY, so the use of such gear is unlikely.

4.3.1.3.5 Effects of Time/Area Management under Alternative 3

Fishing season would be significantly different than the other alternatives. The primary effect of seasonal closures is modeled under the trip limit tool for this alternative (see above).

RCAs similar to *status quo* would be used. RCAs are likely to remain the same as under *status quo* in the near future due to rebuilding requirements of overfished species, however.

Alternative 3 application of time/area closures therefore rank the same as *status quo*, or 3 on a scale of 1 - 3.

Effects on Overfished Groundfish The principal tool for this alternative is to reduce time on the water using seasonal closures. Reducing time on the water would allow larger trip limits during open periods. As was pointed out above, this would have a positive benefit as larger trip limits tend to reduce bycatch in the form of regulatory induced discard of overfished species. Platooning of the fleet would be done to maintain a year-round flow of groundfish to markets, thus impacts would be comparable to Alternative 2. Compared to *status quo*, this alternative would still have a positive benefit in reducing bycatch and bycatch mortality of overfished species due to the general effect of increased trip limits size. The season may have to be shortened in order to maintain trip limit size. If the season is too short, some fishers may be elect not to fish. Overall catch of overfished species my decline or trip limits could be increased. The impact of effort reduction due to fishers opting out, would be a reduction in bycatch and bycatch mortality of overfished species.

Effects of on Emphasis Species In addition to the RCAs described under Alternative 1, the principal tool for this alternative is to reduce time on the water using seasonal closures. Depending on the timing of a seasonal closure, bycatch and bycatch mortality may be reduced. If platooning is considered as an option, fisheries outside of the RCAs might be feasible as increased trip limits would provide some flexibility in application of ratio management. For example, the DTS fishery could provide year round opportunities for a platooned fleet with larger trip limit sizes. In addition, a significant proportion of flatfish are distributed shoreward of RCAs, there may be an opportunity to have exceptions to closures for the shallow water flatfish fishery.

4.3.1.3.6 Effects of Capacity Reduction under Alternative 3

Capacity reduction is not used as a tool in this alternative. Therefore this tool is ranked 3 (no effect) on a scale of 1 - 3.

4.3.1.3.7 Effects of Data Reporting, Record-keeping, and Monitoring under Alternative 3

Higher levels of monitoring yield more complete, accurate, and timely estimates of total catch including bycatch. Indirect benefits would include improved stock assessments and tracking of rebuilding plans. Under Alternative 3, 100% of the at-sea whiting fleet would be monitored by onboard observers; shore-based whiting vessels wold continue to be required to retain all fish brought aboard (as required by an EFP, and soon by regulation) and landings would be observed on shore; and approximately 10% of the non-whiting commercial groundfish fleet would be monitored with on-board observers. Commercial landings data and observer data would be used to estimate the total catch and catch ratios of overfished species co-occurring with other groundfish.

Under Alternative 3, catch reporting, record-keeping, and monitoring through the use of observers may improve over Alternative 1. Assuming the number of observer days remains the same, a higher proportion of total trips and catch would be observed due to the reduced fleet size and (perhaps) reduced total number of trips. If effort increases, trip limits may have to be reduced, and the level of observer coverage would be similar to Alternative 1. This tool is ranked 4 (low), the same as Alternative 2, on a scale of 1 - 5.

4.3.1.4 Impacts of Alternative 4 (Sector and vessel catch limits)

Summary The policy goal of this alternative is to reduce bycatch by modifying the definition of "trip limit" to include CATCH LIMITS for overfished stocks, establishing vessel catch limits for each 2-month period, setting annual catch limits for the various fleet sectors, and establishing an in-season catch monitoring or verification program to ensure all catch is recorded. Trip (retention) limits for non-overfished groundfish would also be used in combination with vessel catch limits. Catch limits and retention limits would expire at the end of each period. Vessels carrying observers would have access to larger trip limits of non-overfished groundfish. In this alternative control of bycatch and bycatch mortality is effected by controlling overall catch and gear efficiency and requiring vessels to stop fishing for all groundfish when a catch limit is reached. Direct control of catch and individual vessel accountability set this alternative apart from the previous alternatives. Individual vessel performance would contribute to sector performance. A fishing sector could, therefore, be closed when the portion of OY allocated to that sector were reached. Other sectors would continue fishing unless an overall OY were reached.

This goal supports Council objectives of preventing overfishing, rebuilding overfished stocks, maintaining a year-round fishing season, and increasing individual and group accountability for their groundfish catches. Fishery monitoring would be increased over Alternative 1; monitoring costs would be higher.

Tools Used The following mix of management measures are applied to create Alternative 4. Tool ranks for Alternative 4 are summarized in Table 4.3.4.

- **Harvest Levels** (harvest policy, rebuilding) Objectives for optimum yield and rebuilding would remain the same as in Alternatives 1, 2, and 3. The harvest policy would be modified from the previous alternatives in that OYs would be subdivided into overfished species limits and non-overfished species guidelines for each fishing sector. Each sector would be monitored separately throughout the season for its progress towards those guidelines and caps. Broad fishery sectors would be specified: three limited entry whiting sectors, limited entry bottom trawl, limited entry fixed gear, open access, and recreational fleets. Because several overfished stocks show geographic variation north to south, the non-whiting sectors could be further subdivided, for example north and south of Cape Mendocino at 40°10' N. Lat. A portion of non-overfished groundfish OYs would be set aside in reserve for the fishery sector with the lowest bycatch to provide further incentive to reduce catch rates of overfished species. When a sector reached any cap, all vessels in the sector must stop fishing for groundfish. When a sector reached a guideline for a non-overfished species, the Council would evaluate whether sufficient OY remains to allow continued fishing without reducing opportunities for other sectors. The primary direct effect of this alternative would be reduced catch and bycatch of overfished while allowing greater harvest of non-overfished species. This tool is ranked 2 (more effective) on a scale of 1-3 (column titled "Performance Standards and OY Reserves" in Table 4.3.4).
- **Vessel trip limits** Vessel trip limits for non-overfished groundfish species would be established sector-by-sector. They would reflect the number of vessels in the sector and the allocations for that sector. Some trip limits might initially be similar to those under Alternative 1, based on previously observed joint catch ratios of overfished and co-occurring groundfish species. Trip limits would apply only to non-overfished species, and would likely be larger than

Table 4.3.4. Alternative 4: Reduce groundfish bycatch establishing vessel and sector catch caps/limits. Relative rank of tools used to reduce bycatch and bycatch mortality. Overfished species in **bold** and emphasis species in *italic.* Species below MSY and subject to precautionary management are noted with (p). Shaded areas reflect change in rank due to fisheries or species characteristics that influence scoring and comparison to other alternatives (see Chapter 4 text describing alternative's effect on emphasis species).

Environment	Species	ABC/OY	Performance standard and OY reserves	Trip limits	Catch limits	Retention requirement	Gear restrictions	Capacity reduction	Time/area management	Monitoring program
			Catch ratios-allocate to sector with reserve	Yes	Vessel and Sector caps	None	Yes	None	RCAs	Increased Observer coverage commercial and CPFV, in-season est.
Northern Shelf	**Canary rockfish**	1	2	2	2	2	2	3	3	2
	Lingcod	1	2	2	2	2	2	3	3	2
	Yelloweye rockfish	1	2	2	2	2	2	3	3	2
	Yellowtail rockfish	1	2	2	3	2	2	3	3	2
	Arrowtooth flounder	1	2	3	3	2	2	3	3	2
	English sole	1	2	3	3	2	2	3	3	2
	Petrale sole	1	2	3	3	2	2	3	3	2
Southern Shelf	**Boccacio**	1	2	2	2	2	2	3	3	2
	Cowcod	1	2	2	2	2	2	3	3	2
	Chilipepper	1	2	3	3	2	2	3	3	2
Slope	**Darkblotched rockfish**	1	2	2	2	2	2	3	3	2
	Pacific Ocean Perch	1	2	2	2	2	2	3	3	2
	Dover sole (p)	1	2	2	3	2	2	3	3	2
	Sablefish (p)	1	2	2	3	2	2	3	3	2
	Shortspine thornyhead (p)	1	2	2	3	2	2	3	3	2
	Longspine thornyhead	1	2	3	3	2	2	3	3	2
Pelagic	**Widow rockfish**	1	2	2	2	2	2	3	3	2
	Pacific whiting	1	2	2	2	2	2	3	3	2
Nearshore	*Black rockfish*	1	2	2	3	2	2	3	3	2
	Cabezon	1	2	2	3	2	2	3	3	2
	Scale	1	1 to 3	1 to 4	1 to 4	1 to 2	1 to 3	1 to 3	1 to 3	1 to 5

under the previous three alternatives because they would be based more directly on OYs for those species and on the membership and participation of the various sectors. Trip limits would be modified sector-by-sector. Monitoring would be more extensive and timely than under the previous alternatives. Catch/bycatch data on a sector-by-sector basis would be available inseason. If a sector reached an allocation of a non-overfished species, trip limit adjustments would be made case-by-case; if substantial OY remained and it appeared other sectors would not use it, continued fishing could be allowed. To the degree that limits were liberalized, bycatch and bycatch mortality of non-overfished species may be reduced. This tool ranks 2 for some species and 3 for other species on a scale of 1 - 4.

- **Catch Limits** Restricted species catch limits for overfished groundfish (and perhaps other species needing reduced harvest) would be established for all limited entry vessels. These caps may be different for different sectors because the numbers of vessels in each sector may be different, and the sector allocations and caps may also be different. All vessels within a sector would have the same restricted species catch limits. As with trip limits, these catch limits would not be transferable and would expire at the end of each period (that is, they could not be carried over to the next period). In contrast to trip limits, a vessel must stop fishing when it reaches any restricted species catch limit until the next period begins. Annual sector allocations would be used to partition available amounts of these species among sectors. When a vessel is observed to reach a restricted species catch limit, it must stop fishing for the remainder of the period. When an annual sector cap is reached or projected to be reached, all vessels in that sector must stop fishing until the next year or until allowed to start again. The increased incentive to avoid catching overfished groundfish and the reduction of incentives to discard under this alternative would be expected to reduce bycatch of overfished groundfish substantially. Facing the possibility of being shut down due to reaching a restricted species catch limit or sector cap, vessels would be more likely to retain all usable fish. Increased monitoring and sector management measures would increase the incentives to keep within sector caps reducing bycatch and bycatch mortality compared to the first 3 alternatives. This tool is ranked 2 for some species and 3 for others on a scale of 1 - 4.
- **Gear Regulations** Gear regulations under this alternative would be the same or similar to Alternative 1, and would be

structured to keep catches within the OY limits for overfished species. Incentives would be stronger to modify gear in order to reduce bycatch and bycatch mortality, due to strict caps and robust monitoring system of this alternative. Gear modifications that reduced the take of overfished rockfish outside of RCAs would have a direct beneficial impact on bycatch and bycatch mortality, compared to the first three alternatives. The fate of excluded fish is unknown. Fish interacting with and escaping fishing gear may succumb to delayed mortality even though bycatch in the form of discards is reduced. This tool is ranked 2 for some species (moderate) and 3 (little effect) for other species on a scale of 1 - 3 .

- **Time/Area Management** Initially, time and area closures (MPAs/RCAs) would be similar to those under Alternative 1, and would be based on the previously observed catch ratios of various groundfish species. Some additional flexibility might be possible due to increased monitoring and updating of catch ratios and performance of the fishing sectors. This alternative may allow changes in time or depth of RCAs based on more extensive monitoring data as the observer program would likely be more finely stratified than under the *status quo* alternative. Reduction in the extent of the current MPAs/RCAs would be intended not to allow increased catch/bycatch of overfished species, but could result in bycatch of other species. The application of this tool is similar to the three previous alternatives and is ranked 3 (no additional effect) on a scale of 1 - 3.
- **Capacity Reduction** Further capacity reduction is not included in this alternative. Therefore, it has is ranked 3 (no effect) on a scale of 1 - 3.
- **Data Reporting, Record-keeping, and Monitoring** This alternative would establish a more robust catch reporting, record keeping, and monitoring program than Alternative 1. Full (100%) logbook coverage would be required to improve the accuracy of estimated catch by commercial and charter boats. A subset of vessels within each sector would be chosen randomly and observed. (For vessel caps to be fully functional, every vessel would have to be observed.) Incidental catch rates of observed vessels would be quickly tabulated and applied to non-observed vessels of the sector. Vessels within a sector could also voluntarily pay for and carry an observer in order to have access to higher trip limits. Recreational sampling would be also be increased. In-season monitoring of commercial and recreational fisheries would ensure caps would not be exceeded by any

given sector. These controls would have a direct effect of reducing bycatch of overfished species compared to the first three alternatives. Discard may also be reduced in the commercial fishery compared to the first three alternatives as fishers are more likely to retain catches of all usable fish, including overfished species. Bycatch mortality of fish caught and released in the recreational fishery is unknown. This tool is ranked 2 (high) on a scale of 1 - 5.

Impacts on Groundfish The effects of the tools and tool applications used to reduce groundfish bycatch, bycatch mortality, and to increase individual and sector accountability in Alternative 4 are ranked and summarized in Table 4.3.4. Effects are ranked in comparison to the other alternatives. Lower numbers indicate a greater effect.

Overfished species Under this alternative, overfished species OYs would be subdivided into caps for each fishing sector; non-overfished species OYs would be subdivided into guidelines for each sector. A subset of vessels in each sector would be observed and catch/bycatch rates expanded to unobserved vessels inseason. Within each sector, overfished species catch limits (RSCs) would be assigned to each vessel. When a vessel reached a catch limit (RSC), it would be required to cease fishing. When a sector cap was reached or projected to be reached, all vessels in that sector must stop fishing. Intensive monitoring (observer coverage) would ensure success of this bycatch mitigation program. The primary direct effect of this alternative would be reductions in bycatch of overfished species due to strict caps, individual vessel catch limits, and monitoring of these species. It is highly likely that the shelf dwelling canary rockfish and bocaccio will present the biggest challenge to sectors because of their wide distributions and susceptibility to diverse gears. Current harvest levels for these two species are very close to the OYs. Catches of some other overfished species are below their OYs largely due to fishing constraints caused by canary rockfish and bocaccio. Thus, impacts of trip or catch limits on the various species would differ. Bycatch reduction impacts on overfished species with catch limits would rank higher than other emphasis groundfish species (see below).

There is some question as to whether incentives work on a fishery sector basis. Huppert *et al.* (1992) suggested that sector based incentive systems tend to penalize those participants who adopted methods of reducing bycatch of prohibited species as fewer target species are likely to be caught. Sector based incentive programs work best for relatively small and discreet fishing units like fishing co-operatives. The Pacific whiting fishery sector uses a similar program to limit harvest of salmon incidental catch. Catch limits for overfished species applied to individual vessels and closely monitored should provide stronger incentives than sector limits alone. Impacts of catch limits on individual vessels under a comprehensive monitoring program would be similar to Alternative 5.

The limited entry fixed gear fleet might be successful in limiting the sector's bycatch of certain non-target species of concern (halibut, lingcod, and overfished rockfish), as the catch of those species is relatively small and fishing methods relatively selective. In contrast, the large recreational sector may have a difficult time controlling catch of overfished species through an incentive program because there are many and diverse participants. Thus, other means of controlling this sector's catch would likely be necessary.

Cumulative trip limits for non-overfished groundfish species would be increased for those vessels carrying observers. Cumulative trip limits for the entire sector could be relaxed in size to the extent fleet sectors were able to minimize bycatch of overfished species. Gear modifications would be encouraged to reduce the take of overfished species.

<u>Emphasis Species</u> Close monitoring of sector caps for overfished species could further constrain harvest of co-occurring (non-overfished) groundfish, especially if unobserved participants in a sector did not apply bycatch reducing fishing tactics. A reduction in effort could result from early attainment of restricted species catch limits and overfished species sector caps. This may result in less harvest of other groundfish, thus reducing bycatch and bycatch mortality at the expense of lost economic opportunity. On the other hand, incentives, in the form of larger trip limits for observed vessels, and access to a reserve later in the year for the fishing sector, may change enough of each sector's fishing practices to reduce bycatch of overfished species and increase catch of other groundfish. Individual vessel restricted species catch limits would apply only to overfished species, with trip limits applied to other species. Sector harvest guidelines rank lower than restricted species catch limits for their effectiveness in reducing bycatch (See shaded boxes under "Trip Limits" and "Catch Limits" columns in Table 4.3.4).

Increased cumulative retention limits might result if bycatch of overfished species were well controlled using vessel restricted species catch limits, sector caps, incentives and gear modifications. This could result in increased access to those non-overfished groundfish with higher market value or demand. Bycatch may be reduced for some species such as Dover sole, shortspine thornyhead, sablefish, and yellowtail rockfish. Increased cumulative limits would have less impact on species that are constrained by market limits (some flatfishes and chilipepper rockfish, for example) rather than regulatory limits.

4.3.1.4.1 Effects of Harvest Levels under Alternative 4

Objectives for optimum yield and rebuilding would remain the same as in s*tatus quo.* Harvest policy would be modified from *status quo* in that OYs would be subdivided into caps allocated to each fishing sector with in-season monitoring of caps. Performance standards and sector allocations with OY reserves should have a significant effect, reducing potential bycatch and bycatch mortality compared to Alternatives 1-3. This tool, as used in Alternative 4, is ranked 2 (highly effective) on a scale of 1- 4.

<u>Effects on Overfished Groundfish</u> Under this alternative, overfished species OYs would be broken down into caps for each fishing sector with in-season monitoring of caps. When OY is reached, further fishing would be prohibited or severely curtailed. A portion of other groundfish OY would be set aside in reserve for each fishery sector to provide an incentive to lower catch rates of overfished species. If successful, the primary direct effect of this alternative would be reductions in bycatch of overfished species due to strict caps and monitoring of these species. It is highly likely that the shelf dwelling canary rockfish and bocaccio will present the biggest challenge to sectors. Current harvest levels under *status quo* conditions are very close to OY. Catch of other overfished species are below OY largely due to fishing constraints caused by these two species.

There is some question as to whether incentives work on a fishery sector basis. Huppert *et al.* (1992) suggested that sector based incentive systems tend to penalize those participants who adopted methods of reducing bycatch of prohibited species as fewer target species are likely to be caught. Sector based incentive programs work best for relatively small and discreet fishing units like fishing co-operatives. The Pacific whiting fishery sector utilizes a similar program to limit harvest of salmon incidental catch.

The limited entry fixed gear fleet would likely be successful limiting bycatch of non-target species of concern (halibut, lingcod, and overfished rockfish), as the catch of overfished species is small. In contrast, the recreational sector may have a difficult time controlling catch of overfished species through an incentive program as there are many and diverse participants. Thus, other means of controlling this sectors OY cap would likely be more effective.

Effects on Emphasis Species Close monitoring of sector caps for overfished species could further constrain harvest of co-occurring other groundfish, especially if sector participants ignored incentives and did not apply bycatch reducing fishing tactics. A reduction in effort could result from early attainment of overfished species sector caps. The direct impact of OY caps may result in less harvest of other groundfish, thus reducing bycatch and bycatch mortality at the expense of lost economic opportunity. On the other hand, incentives, in the form of additional OY for the fishing sector may change enough of the sectors fishing practices to reduce bycatch of overfished species and increase catch of other groundfish. If bycatch is proportional to catch, bycatch and bycatch mortality may increase for other groundfish.

4.3.1.4.2 Effects of Vessel Trip Limits under Alternative 4

Vessel trip limits would initially be the same as *status quo* and based on previously observed joint catch ratios of overfished species and various groundfish species. Trip limits might be relaxed (increased) depending on the performance of fleet sectors at maintaining catch caps. Trip limits under this alternative are given a rank of 2 (very effective) for some species and 3 (somewhat effective) for other species on a scale of 1 - 4.

Effects on Overfished Groundfish Vessel trip limits could be altered compared to the status quo due to more careful monitoring of catch, and vessel incentives to minimize catch and bycatch of overfished species, as the season progresses. To the degree that limits were liberalized, bycatch and bycatch mortality of overfished species may be reduced. Alternative 4 applies caps on a sector basis. Individual vessels may not have as strong of an incentive to avoid overfished species as in

Alternatives 5 and 6. Therefore, it is likely that the greatest source of bycatch reduction is likely to be due to increased retention rates for bottom trawlers.

Studies of Alaska fisheries have shown that sector caps work with small identifiable fishing units, like cooperatives. The west coast whiting fleet is organized along similar lines and appear successful at implementing voluntary caps on bycatch of prohibited species. Under this alternative, a pelagic fishery catch cap for overfished shelf rockfish and widow rockfish may effectively managed by Pacific whiting cooperatives.

Effects on Emphasis Species Limit changes under this alternative are not likely to affect those species with catch levels below existing cumulative catch limits, especially if they are market limited. Effects of potential limit changes on these species were ranked lower than overfished species (see shaded scores under Trip limits in Table 4.3.4). Catches of more desirable species, like yellowtail rockfish, currently harvested below cumulative catch limits due to constraints associated with overfished species may be more accessible if the vessel sector incentive program is successful.

4.3.1.4.3 Effects of Catch Limits under Alternative 4

Restricted species catch limits for overfished groundfish (and perhaps other species needing reduced harvest) would be established for all limited entry vessels. These caps may be different for different sectors because the numbers of vessels in each sector may be different, and the sector allocations and caps may also be different. All vessels within a sector would have the same restricted species catch limits. As with trip limits, these catch limits would not be transferable and would expire at the end of each period (that is, they could not be carried over to the next period). In contrast to trip limits, a vessel must stop fishing when it reaches any restricted species catch limis until the next period begins. Annual sector allocations would be used to partition available amounts of these species among sectors. When a vessel is observed to reach a restricted species catch limit, it must stop fishing for the remainder of the period. When an annual sector cap is reached or projected to be reached, all vessels in that sector must stop fishing until the next year or until allowed to start again. The increased incentive to avoid catching overfished groundfish and the reduction of incentives to discard under this alternative would be expected to reduce bycatch of overfished groundfish substantially. Facing the possibility of being shut down due to reaching a restricted species catch limit or sector cap, vessels would be more likely to retain all usable fish. Increased monitoring and sector management measures would increase the incentives to keep within sector caps reducing bycatch and bycatch mortality compared to the first 3 alternatives. This tool is ranked 2 for some species and 3 for others on a scale of 1 - 4.

4.3.1.4.4 Effects of Gear Restrictions under Alternative 4

Management under Alternative 4 would include incentives to modify gear as an aid in reducing bycatch and bycatch mortality and keeping under strict vessel and sector caps. Gear restrictions as applied under Alternative 4 are assigned a rank 2 on a scale of 1 - 3 among alternatives.

<u>Effects on Overfished Groundfish</u> Gear modifications that reduced the take of rockfish outside of RCAs may have a direct positive impact on bycatch and bycatch mortality of overfished species, compared to the first three alternatives. Depending on the type of gear modification, some un-observed impacts may occur leading to bycatch mortality. Little is known about the survivability of fish escaping through meshes or escape panels. Fish excluder devices that eliminate overfished rockfish species provide a better opportunity for survival than sorting and discarding fish at the surface, which is generally lethal for rockfishes (see discussion under Alternative 1 *status quo* and Davis and Ryer (2003)). Cut-back trawls are being experimented with under EFPs. These nets are thought to be highly selective for flatfish and may allow rockfish to avoid capture without contact (Parker 2003).

With caps applied on a sector basis however, individual vessels may not have as strong of an incentive to modify gear to eliminate take of overfished species as in Alternatives 5 and 6 (see discussion above under **Harvest Levels**).

<u>Effects on Emphasis Species</u> It is hoped that incentives to modify gear to reduce bycatch and bycatch mortality of overfished species would be strong, due to strict caps and robust monitoring system. If sector based caps are successful at minimizing bycatch of overfished species, more of the OY for other groundfish should be accessible. The midwater trawl fishery may be successful in taking yellowtail rockfish without excessive bycatch of widow rockfish for example. The DTS fishery might enjoy a large portion of overall OY if, through incentives, undersized sablefish and shortspine thornyhead

bycatch could be reduced. Impacts to nearshore flatfish bycatch and bycatch mortality are unknown as changes in gear are likely to be done to reduce impacts to overfished species. As pointed out above, the strength of the incentives depends on changes in gear and behavior on the part of the entire sector in order. There may not be as strong as incentive as possible if caps were applied on an individual vessel basis (See Alternatives 5 and 6).

4.3.1.4.5 Effects of Time/Area Management under Alternative 4

Initially time and area closures (RCAs) would be similar to those under *status quo*, and would be based on the previously observed catch ratios of various groundfish species. Some limited additional flexibility in defining RCAs might be possible if fleet sector response to sector caps reduces bycatch. Time/area management as applied under Alternative 4 is given a rank of 3 (no additional effect over the *status quo*) on a scale of 1 - 3.

<u>Effects on Overfished Groundfish</u> This alternative may allow changes in time or depth of seasonal RCAs if fleet sectors are successful at maintaining harvest levels of overfished species at or below OY sector caps. Impacts to bycatch and bycatch mortality of overfished species would likely be the same as under *status quo*. Gains made due to successful fleet response to sector caps may be offset somewhat if managers change RCA boundaries to allow new opportunities to harvest other groundfish. Encounter rates with overfished shelf rockfish could increase as a result. If fishers retain overfished species, overall bycatch should be less than *status quo.*

<u>Effects on Emphasis Species</u> Initially time and area closures (RCAs) would be similar to those under *status quo*, and would be based on the previously observed catch ratios of various groundfish species. Impacts to bycatch and bycatch mortality would likely be the same as under *status quo.* If RCA boundaries are changed to allow more access to other groundfish, catch, bycatch and bycatch mortality of other shelf groundfish could increase somewhat.

4.3.1.4.6 Effects of Capacity Reduction under Alternative 4

Further capacity reduction is not included in this alternative. Therefore, it has is ranked 3 (no effect) on a scale of 1-3.

4.3.1.4.7 Effects of Data Reporting, Record-keeping, and Monitoring under Alternative 4

Higher levels of monitoring yield more complete, accurate, and timely estimates of total catch including bycatch. Indirect benefits would include improved stock assessments and tracking of rebuilding plans. Under Alternative 4, 100% of the at-sea whiting fleet would be monitored by onboard observers; and shore-based whiting vessels wold continue to be required to retain all fish brought aboard (as required by an EFP, and soon by regulation) and landings would be observed on shore.

Under Alternative 4, observer coverage would be redesigned to ensure that each sector's bycatch of overfished groundfish species is accurately assessed and recorded, with results available for management purposes inseason. A minimum rate observation of each sector would be approximately 10% or as determined by statistical sample design methods. Full (100%) logbook coverage for each sector would be required to improve the accuracy of estimated catch by commercial and charter boats. Commercial landings data and observer data would be expanded sector-by-sector to all vessels in each sector. Vessels observed to achieve any catch limit of overfished species (or other restricted species catch limit) would be required to stop fishing for the remainder of the designated period. Vessels observed to stay below all restricted species limits would be authorized to continue fishing for additional target species; that is, larger trip limits would be available for vessels carrying observers. It may be possible to use video monitoring in conjunction with full retention and shoreside sampling to achieve the same level of catch verification.

The catch reporting, record keeping, and monitoring program established by Alternative 4 would be substantially more robust than Alternatives 1, 2 and 3. For vessel caps to be fully functional, every vessel would have to be observed. Incidental catch rates of observed vessels would be quickly tabulated and applied to non-observed vessels of the sector. Vessels within a sector could also voluntarily pay for and carry an observer in order to have access to higher trip limits. Recreational sampling would be also be increased. In-season monitoring of commercial and recreational fisheries would ensure caps were not exceeded by any given sector. These controls would have a direct effect of reducing bycatch of overfished species compared to the first three alternatives. Discard may also be reduced in the commercial fishery compared to the first three alternatives as fishers are more likely to retain catches of all usable fish, including overfished species. Bycatch mortality of fish caught and released in the recreational fishery is unknown. The application of this tool is ranked 2 to 3 (highly effective) on a scale of 1 - 5 compared to the alternatives. The ranking depends on the level of observer coverage (whether 100% coverage is achieved or some lesser coverage rate of each sector).

4.3.1.5 Impacts of Alternative 5 (Individual Fishing (Catch) Quotas and Increased Retention)

Summary The policy goal of this alternative is to significantly reduce bycatch by limiting every limited entry commercial vessel's groundfish catches through the use of annual, transferable, restricted species catch quotas (RSQs) for overfished species and transferable individual fishing quotas (IFQs) for other groundfish. These quotas would be mortality limits for each species. Direct control of catch and individual vessel accountability sets this alternative apart from Alternatives 1, 2 and 3; the use of annual catch limits that are transferable sets this apart from Alternative 4. A robust monitoring or catch verification program would be implemented to ensure reporting of all catch. Discarding of overfished species would be prohibited; discarding of other species would not be prohibited, but all catch would apply towards the IFQs. Gear regulations would be relaxed, allowing fishers the ability to modify gear and operations to avoid catch of overfished species and reduce unwanted bycatch of all species. Regulations could be amended to allow trawl vessels to use non-trawl gears where increased selectivity for certain species is possible. A portion of some OYs would be reserved for vessels with the lowest bycatch rates or amounts.

This goal supports Council objectives of preventing overfishing, and rebuilding overfished stocks, and maintaining a year-round fishing season. Fishery monitoring is increased substantially over Alternatives 1, 2 and 3, and less substantially over Alternative 4. Increased monitoring also means increased costs.

Tools Used The following mix of management measures are applied to create Alternative 5. Tool ranks are summarized in Table 4.3.5.

- **Harvest Levels** OYs would remain the same as in Alternative 1, however distributions of available OYs would be broken down into individual quotas (mortality limits) for each commercial limited entry vessel. A reserve of various species could be set aside for vessels with the lowest catches or catch ratios of overfished species. Any unused OYs would be made available to those vessels that had not taken their overfished species limits. The primary direct effect of this alternative would be reductions in bycatch due to strict caps and monitoring of overfished species harvest. Discard of overfished species would be prohibited, eliminating all regulatory bycatch of those species. Vessels would increase their avoidance of overfished species in order to access larger amounts of non-overfished species; markets would develop for quota shares, and RSQs would be the most valuable. This tool ranks 1 (highly effective) on a scale of 1 - 3.

- **Vessel trip limits** Vessel trip limits would be relaxed or absent, as each vessel would have an individual caps on overfished and other groundfish species. Direct effects expected under this alternative compared to Alternative 1 would be a reduction in regulatory induced discard of overfished species due to the absence of trip limits. This tool ranks 1 (highly effective) on a scale of 1 - 4 for reducing bycatch.
- **Vessel Catch Limits** Individual vessel caps in the form of transferable restricted species catch limits (RSQs) for overfished stocks and individual transferable fishing quotas (IFQ) for other groundfish species would be established with this alternative. Bycatch/discard of overfished groundfish would be nearly eliminated, along with regulatory bycatch of non-overfished species. Individual catch quotas would work positively to minimize discard of all groundfish species because all catch would apply to the relevant limit. Vessels must stop fishing upon reaching any catch quota or obtain additional quota to continue fishing. Vessels with the lowest catch rates of overfished species would have the greatest access to additional fishing. Application of IFQ would not necessarily eliminate discard of non-overfished groundfish, but would increase the economic incentive to retain all usable fish. Direct effects expected under this alternative compared to *status quo* would be a near elimination of discard/bycatch of all species with RSQs and substantial reduction of discard/ bycatch of other groundfish. This tool ranks 1or 2 (highly effective) on a scale of 1 - 4, depending on the species.
- **Gear Regulations** Gear regulation would be more flexible than under Alternative 1. Gear modification, and perhaps

Table 4.3.5. Alternative 5: Reduce groundfish bycatch by establishing individual transferable quotas (RSQ or IFQ). Relative rank of tools used to reduce bycatch and bycatch mortality. Overfished species in **bold** and emphasis species in *italic.* Species below MSY and subject to precautionary management are noted with (p). Shaded areas reflect change in rank due to fisheries or species characteristics that influence scoring and comparison to other alternatives (see Chapter 4 text describing alternative's effect on emphasis species).

Environment	Species	ABC/OY	Performance standard and OY reserves	Trip Limits	Catch limits	Retention requirement	Gear restrictions	Capacity reduction	Time/area management	Monitoring program
			Yes with OY reserve	None	Individual vessel RSQ and IFQs	Retain overfished	Flexible	RSQ & IFQ sales	Areas closed to bottom fishing	100% Observer coverage commercial and CPFV, Inseason est.
Northern Shelf	**Canary rockfish**	1	1	1	1	1	1	1	2	1
	Lingcod	1	1	1	1	1	1	1	2	1
	Yelloweye rockfish	1	1	1	1	1	1	1	2	1
	Yellowtail rockfish	1	1	1	2	2	1	1	2	1
	Arrowtooth flounder	1	1	1	2	2	1	1	2	1
	English sole	1	1	1	2	2	1	1	2	1
	Petrale sole	1	1	1	2	2	1	1	2	1
Southern Shelf	**Boccacio**	1	1	1	1	1	1	1	2	1
	Cowcod	1	1	1	1	1	1	1	2	1
	Chilipepper	1	1	1	2	2	1	1	2	1
Slope	**Darkblotched rockfish**	1	1	1	1	1	1	1	2	1
	Pacific Ocean Perch	1	1	1	1	1	1	1	2	1
	Dover sole (p)	1	1	1	2	2	1	1	2	1
	Sablefish (p)	1	1	1	2	2	1	1	2	1
	Shortspine thornyhead (p)	1	1	1	2	2	1	1	2	1
	Longspine thornyhead	1	1	1	2	2	1	1	2	1
Pelagic	**Widow rockfish**	1	1	1	1	1	1	1	2	1
	Pacific whiting	1	1	1	1	1	1	1	2	1
Nearshore	*Black rockfish*	1	1	1	2	2	1	1	2	2
	Cabezon	1	1	1	2	2	1	1	2	2
	Scale	1	1 to 3	1 to 4	1 to 4	1 to 2	1 to 3	1 to 3	1 to 3	1 to 5

the use of alternative gears, would be allowed. Commercial limited entry trawl fishers would be encouraged to experiment with different methods to reduce bycatch of overfished species. The distinction between limited entry longline and pot permits could be eliminated, and/or those vessels allowed to use open access line gear to reduce their catch of overfished species. Strict caps and a robust catch monitoring system would reduce the need for gear regulations as the primary bycatch mitigation tool. Thus, gear regulations would become less important and innovation would be encouraged; therefore this tool is ranked 1 (most effective) on a scale of 1 - 3.

- **Time/Area Closures** In the short term, MPAs would be applied in a manner similar to the first four alternatives. However, under an RSQ/IFQ program, RCAs as they are currently used may become less important and less necessary as a tool to reduce groundfish bycatch. Once an individual vessel's RSQ/IFQ is attained, the vessel would be required to cease fishing for groundfish until additional quota is obtained. There may some limited circumstances where continued fishing might be allowed where the likelihood of encountering the particular species would be highly unlikely. Under an individual vessel catch limit/quota program, vessels would have greater incentive to improve the selectivity of their fishing gear and techniques, fishing in areas where they can maximize their profits. MPAs for overfished species would tend to be redundant under this program. However, MPAs for other purposes, such as habitat areas of particular concern, research reserves, etc., might continue to be appropriate or necessary. This tool would continue to be ranked 1 (highly effective) for most species on a scale of 1 - 3.
- **Capacity Reduction** No direct reduction in capacity is considered under this alternative. (See discussions under Alternatives 1 and 2). However, some degree of industry consolidation would be expected under an individual quota program. Capacity reduction accomplished through RSQ/ IFQ sales could have a positive direct effect on overfished species, if a species cap for a vessel is not used by the vessel. Excess quota could be re-distributed to active fishers or left in reserve. This tool ranks 1 (most effective) on a scale of 1 - 3.
- **Data Reporting, Record-keeping, and Monitoring** Increased observer coverage would be required. Although onboard observers would likely monitor fishing locations to a certain extent, VMS would be used to ensure more precise

location and to verify vessels did not fish within an MPA or closed area (PFMC 2003e). Recreational sampling would also be increased under this alternative. Each IFQ vessel would be required to closely track its catches so it would know when it must stop fishing or purchase additional quota. In-season monitoring of the limited entry fishery would thus be vessel-by-vessel; monitoring of the recreational and commercial open access fisheries would be by sector, but increased monitoring may be necessary in order to ensure the quotas of the IFQ fishery are not eroded. This tool application is ranked 1 or 2 (highly effective) on a scale of 1 - 5, depending on the species and fishery.

Impacts on Groundfish The effects of tools used in Alternative 5 on reducing groundfish bycatch, bycatch mortality, and increasing accountability are ranked and summarized in Table 4.3.5. Effects are ranked in comparison to the other alternatives. Lower numbers mean more effective. Greater individual accountability is the hallmark of this alternative. Gear restrictions would be flexible (with the possible exception of gear requirements inside MPAs, where use of bottom fishing gears would likely remain limited). Performance standards (individual quotas and close monitoring) would provide strong incentives for individuals to modify their fishing gear and practices to reduce bycatch of overfished groundfish, minimizing the need for other regulatory intervention. RSQ and IFQ sales would lead to industry consolidation, including further fleet reduction .

<u>Overfished groundfish</u> OY for overfished species would be broken down into RSQs for each fishing vessel with in-season monitoring of caps. When OY is reached, further fishing would be prohibited or severely curtailed. A portion of the OYs of various species would be reserved for vessels with the lowest catches or catch ratios of overfished species. Any unused or reserved OY for other groundfish would be made available to those vessels that had not taken their RSQs.

Catches of canary and bocaccio rockfish are currently very close to their OYs, and the protective harvest levels for these species constrain catches of other co-occurring groundfish. The small individual catch quotas (RSQs) established by Alternative 5 would create strong incentives for vessels to develop gear modifications and fishing strategies to avoid taking the most constraining species. Quota transferability would be important to provide at least limited fishing opportunities even where encounter rates of these two species is low. RSQs for these two species would be very small, perhaps less than 100 pounds per vessel per year. Some fishers would reach their limits prematurely and be closed for much of the year. Some may choose to sell out rather than face the frustration of failure. Some will actively buy up quota share in order to maintain or expand their fishing activities. It is likely many vessels would self-separate into different fishing strategies where they believe they would have the greatest chance of success.

With respect to overfished species, the primary direct effect of this alternative would be reductions in both encounters and discard/bycatch. Individual catch quotas coupled with complete observer coverage would greatly improve catch and bycatch reporting. Vessels would be required to stop fishing or obtain additional quota whenever they reached an RSQ limit. They would actively try to avoid encounters of the most restrictive species. They would be required to retain all overfished species. Thus, overfished species bycatch (discarded catch) should be reduced or eliminated with this alternative. If an overfished species OY were reached, further fishing would be prohibited or severely curtailed.

Trip limits would no longer be used for the commercial limited entry fishery but would likely be used for the open access sector. Gear restrictions would be relaxed to facilitate experimentation in bycatch avoidance methods. In the short term, MPAs (RCAs) would be maintained (although perhaps their boundaries revised) to limit potential encounters with overfished species. In the longer term, such regulatory constraints would be less necessary for overfished species, but may be continued to mitigate bycatch of other species.

<u>Emphasis Species</u> OYs for non-overfished groundfish species would be allocated as IFQs for each limited entry vessel. A portion of some OYs may be reserved for vessels with the lowest catches or catch ratios of overfished species. Any unused OYs would be made available to those vessels that had not taken their overfished species allotments (RSQs).

As was pointed out above, there may be strong incentives to buy and sell RSQ and IFQ shares in order to continue fishing and to develop new strategies. Fishers are currently constrained from fully using several groundfish that are near MSY levels. Under an IFQ program, many may still not be able to fully harvest their IFQs because they used their RSQs in other strategies or to cover unexpected catches. By purchasing additional RSQs of some species (such as canary rockfish), some vessels would be able to make fuller use of their yellowtail rockfish IFQ.

If previous bycatch rate assumptions were lower than actual encounter rates of overfished species, it is likely short term landings of non-overfished species would be reduced. This is because the expanded observer/reporting program would more accurately record bycatch rates. Over time, fishers would improve their ability to avoid overfished species or will be unable to succeed financially. If previous bycatch estimates overestimated the true encounter/bycatch rates, landings would increase because vessels would be able to fish longer than expected. Those fishing strategies that most successfully avoid constraining species while maintaining harvest of healthy stocks will prevail; those with the worst bycatch rates will be phased down. Bycatch of Dover sole, shortspine thornyhead, and sablefish would be expected to be reduced significantly as a consequence, as this complex can often be harvested with low encounter rates of canary rockfish and bocaccio. Under Alternative 5, other groundfish that are not overfished are not required to be retained. The result may be an increase in bycatch and bycatch mortality of other groundfish due to higher catch attainment. Thus, impacts of catch limits on emphasis species have slightly lower ranking compared to overfished species (See gray shaded boxes under catch limit and retention requirement columns in Table 4.3.5).

Some bycatch and discard mortality could still occur if a vessel approaches attainment of its IFQ. There may be some incentive to finish out the season by spreading out the remaining IFQ in order to maintain the supply of groundfish to the market. In addition, some bycatch and bycatch mortality beyond the IFQ could occur on the last trip when the IFQ is reached. Provisions to carry-over unused quota, or borrow from the next year's, would mitigate this.

Market limits may still have an impact on bycatch and bycatch mortality, as they would continue to exist in the absence of regulatory limits. Low bycatch rates of some species would remain low due to restrictions in MPAs.

If midwater trawl vessels targeting whiting (or widow rockfish) were allowed to operate in areas closed to bottom trawling, incidental catch of emphasis species would occur, but at a lower rate.

4.3.1.5.1 Effects of Harvest Level Specifications under Alternative 5

Harvest Levels would differ from *status quo* in that OYs would be allocated to individual vessels in the form of RSQ and IFQ shares with a portion held in reserve. Performance standards and OY reserves are required by this alternative. Harvest caps cannot be exceeded by individual vessels and overfished species must be retained. Shares may be purchased in order to continue fishing. This alternative ranks 1out of a range of 1 - 3 in terms of performance standards and OY reserves.

<u>Effects on Overfished Groundfish</u> OY for overfished species would be broken down into RSQs for each fishing vessel with in-season monitoring of caps. When OY is reached, further fishing would be prohibited or severely curtailed. A reserve of various species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Any unused or reserve OY for other groundfish would be made available to those vessels that had not taken their overfished species OY share.

Canary rockfish and bocaccio catches are currently very close to OY, and constrain catches of other co-occurring groundfish. Under this alternative, incentives would be strong to develop specific gear modifications and adopt new fishing strategies to avoid taking these species. Without transferability, it might be impossible to conduct a fishery where encounter rates of these two species is high. OY shares under this alternative will be very small on a per vessel basis. One indirect effect will be a partitioning of the fleet into different fishing strategies, as vessel owners buy and sell RSQ and IFQ shares to make fishing practical and profitable for a particular strategy.

The primary direct effect of this alternative would be reductions in bycatch due to strict caps and monitoring of overfished species harvest. Thus, overfished species bycatch (discarded catch) should be reduced or eliminated with this alternative as there would be less incentive to do so. Discarded fish counts against the IFQ and observer coverage under this alternative is 100% of the commercial fleet. Some discarding could continue in minor nearshore and recreational fisheries.

<u>Effects on Emphasis Species</u> OY for other groundfish would be broken down into IFQs for each fishing vessel with in-season monitoring of caps. A reserve of various species would be set aside for vessels with the lowest catches or catch ratios of

overfished species. Any unused OY would be made available to those vessels that had not taken their overfished species allotment. When OY is reached, further fishing would be prohibited or severely curtailed, unless additional IFQ share was purchased.

As was pointed out above, there may be strong incentives to buy and sell RSQ and IFQ shares in order to more selectively fish using different strategies. Fishers are not currently able to access other groundfish at or near MSY levels. As an example, some fishers may successfully modify gear and/or purchase enough canary rockfish RSQ to take advantage of yellowtail rockfish IFQ.

If enough fishers are successful at acquiring RSQ shares and/or are able to make appropriate gear modifications to catch more OY of other groundfish then catches of more species may move toward OY levels. The result may be an increase in bycatch and bycatch mortality of other groundfish due to higher catch attainment.

Some bycatch and discard mortality could still occur if a vessel approaches attainment of the IFQ. There may be some incentive to finish out the season by spreading out the remaining IFQ in order to maintain the supply of groundfish to the market. In addition, some bycatch and bycatch mortality could occur on the last trip when the IFQ is reached.

4.3.1.5.2 Effects of Trip Limits under Alternative 5

Vessel trip limits would be relaxed or absent. Essentially the trip limit would amount to the RSQ or IFQ that could be taken on an annual basis. Markets may influence trip size, however, and some bycatch and bycatch mortality may occur as a consequence. See discussion above under **Harvest Levels**. Trip limits under this alternative rank 1 on a scale of 1 - 4.

<u>Effects on Overfished Groundfish</u> There would be no need for a trip limit as each vessel would have an individual cap on overfished species and an ITQ for other groundfish species. Direct effects expected under this alternative compared to status quo would be a reduction in regulatory induced discard of overfished species due to relaxed trip limits.

Effects on Emphasis Species Vessel trip limits would be relaxed or absent, as each vessel would have an individual RSQ cap on overfished species and an IFQ for other groundfish species. Under this alternative, regulatory induced discards of other groundfish are not anticipated. Market induced discard resulting from size, price, and quantity requirements would be expected.

4.3.1.5.3 Effects of Catch Limits under Alternative 5

Transferable individual vessel RSQs for overfished species would be established with this alternative. Transferable IFQs would be established for other groundfish species (See discussion under **Harvest Levels**). Overfished species would have to be retained and discarded catch of other species would count against a vessels quota. Bycatch and bycatch mortality would therefore be significantly reduced. compared to other alternatives not using individual quotas. Vessel catch limits in the form of RSQs and IFQs are ranked 1 for those species currently constrained by trip limits, and 2 for species that are currently constrained by market, on a scale of 1 - 4.

Effects on Overfished Groundfish Individual catch limits should work positively to reduce discard of overfished species to near zero, due to a 100% retention requirement and relaxed trip limits. Regulatory induced discard associated with trip limits should be also be eliminated. OY reserves would provide incentives to minimize catch of overfished species.

RSQ shares would need to be purchased if a fisher needed more share of groundfish to continue fishing. Shares of canary rockfish and bocaccio in particular would be very small on a per vessel basis. Fishers are likely to purchase RSQ shares to participate in a fishing strategy that increases the likelihood of encountering canary rockfish and bocaccio. Direct effects expected under this alternative compared to status quo would be a reduction in regulatory induced discard of overfished species.

Effects on Emphasis Species Individual transferable quotas (IFQs) would be established for other groundfish species. Regulatory induced bycatch for some species of other groundfish like yellowtail rockfish and shortspine thornyhead could be avoided due to relaxed trip limits. IFQ shares will need to be purchased if a fisher needed more share of groundfish to continue fishing. Vessel catch limits are not expected to change bycatch and bycatch mortality of some groundfish species currently limited by market factors.

Sablefish is not currently overfished and 100% retention would not be required. Some high-grading and discard is likely to occur with this species. English sole is another example of a species limited primarily by market factors. Bycatch of some species could increase if a vessel owner sold IFQ shares for some species and continued to fish in an area for other species.

4.3.1.5.4 Effects of Gear Restrictions under Alternative 5

Gear restrictions would be more flexible than *status quo.* Individual fishers would have the choice to modify gear to reduce efficiency, but would not be required to do so. Since regulatory gear requirements would be relaxed, fishers could also develop gear to more efficiently take a particular species. As a bycatch and bycatch mortality reduction tool, a rank of 1 (highest) on a scale of 1 - 3 was assigned to the approach used in this alternative, because gear innovation would be facilitated and encouraged by the economic incentives for vessels to achieve optimal bycatch rates.

<u>Effects on Overfished Groundfish</u> Gear modification would be facilitated allowing fishers to experiment with different methods to reduce bycatch of overfished shelf rockfish species. Strict caps and a robust catch monitoring system would allow relaxation of the EFP process normally required for modified gear. To the degree gear modifications were successful, this alternative may have a positive direct effect of reducing bycatch and bycatch mortality of overfished species. A more likely scenario is a reduction in bycatch due to higher retention rates, as fishers by and sell RSQ shares to develop selective fishing strategies that allow more access to other groundfish..

<u>Effects on Emphasis Species</u> Gear regulation would be more flexible, allowing experimentation and modification to reduce bycatch and bycatch mortality of overfished species. The impact of such modifications on other groundfish is unknown.

4.3.1.5.5 Effects of Time/Area Management under Alternative 5

Time/Area management would be based more on need to protect sensitive species, to protect essential fish habitat, and protect other benthic animals such as corals and other invertebrates. In order to accomplish this, the alternative proposes closures of areas to groundfish gears that make bottom contact. The method this tool is used in Alternative 5 is ranked 2 on a scale of 1-3 for its effectiveness in reducing bycatch and bycatch mortality of demersal bottom dwelling species, as compared to the alternatives.

Effects on Overfished Groundfish The cowcod conservation areas would remain in effect to accomplish rebuilding. The RCAs established to conserve other overfished shelf species would also remain in effect, minimizing bycatch and bycatch mortality within those areas. Fishing with midwater trawl gear for Pacific whiting and widow rockfish would be allowed withing the RCAs, the same as under Alternatives 1-4. Some reduction in the catch, bycatch and bycatch mortality of Pacific whiting and widow rockfish would continue to result from restrictions on bottom trawls and other gears in the RCAs.

Effects on Emphasis Species The anticipated effects would be similar to those for overfished species; some reduction in the catch, bycatch and bycatch mortality of non-overfished groundfish would continue to result from restrictions on bottom trawls and other gears in the RCAs.

4.3.1.5.6 Effects of Capacity Reduction under Alternative 5

No direct reduction in capacity is applied under this alternative. Some level of fleet consolidation would occur as market forces would favor more efficient vessels. Thus, capacity reduction would be an indirect effect of this approach rather than an intentional or specified result. However, capacity reduction would occur in all sectors, not just the trawl fleet as in Alternative 2. Therefore, this tool is ranked 1 on a scale of 1- 3.

Effects on Overfished Groundfish Some capacity reduction may occur if vessel owners sell RSQ and IFQ shares and elect to fish in a non-groundfish fishery. Capacity reduction accomplished through RSQ and IFQ sales could have a positive direct reducing bycatch of overfished species. Some vessel owners may also chose to fish in other fisheries and hold onto RSQ and IFQ shares. To the degree shares were unused, catch, bycatch, and bycatch mortality would be reduced.

Effects on Emphasis Species See discussion above.

4.3.1.5.7 Effects of Data Reporting, Record-keeping, and Monitoring under Alternative 5

Alternative 5 would require 100% observer coverage of all limited entry commercial vessels and increased monitoring of other groundfish fisheries.

Under Alternative 5, observer coverage would be redesigned to ensure that each commercial limited entry vessel's bycatch of overfished groundfish species is accurately assessed and recorded, with results available for management purposes inseason. Logbooks would not be required or used. Vessels reaching any catch limit of overfished species (or other restricted species catch limit) would be required to stop fishing until they obtain additional quota. This would be until the beginning of the next year unless they purchased quota from a shareholder. A program to monitor quota transfers would be required.

The catch reporting, record keeping, and monitoring program established by Alternative 5 would be substantially more robust than Alternatives 1, 2, 3 and 4, as every limited entry vessel would be observed and monitoring of other sectors would be increased substantially. This would have a direct effect of reducing encounter/bycatch of overfished species compared to the first four alternatives. Discard/bycatch would also be reduced in the commercial fishery compared to the first four alternatives as fishers would be required to retain all overfished groundfish and more likely to retain catches of all usable fish, since all fish would count towards their individual quotas. This tool is ranked 1 (most effective) on a scale of 1 - 5 for its incentive to avoid catching unwanted fish and 2 for reducing discard/bycatch.

4.3.1.6 Impacts of Alternative 6 (No-take Reserves, Individual Catch Quotas, and Full Retention)

Summary The policy goal of this alternative is to reduce bycatch to near zero by establishing large no-take reserves in areas where overfished groundfish are most likely to be encountered, prohibiting discard of most groundfish, and accurately accounting for all catch. This alternative reduces bycatch and bycatch mortality by direct controls on catch, effort, and gear efficiency.

This alternative supports Council objectives for protecting and rebuilding depleted groundfish stocks, but at higher cost for monitoring than *status quo*.

Tools Used The following mix of management measures are applied to create Alternative 6. Tool ranks are summarized in Table 4.3.6.

- **Harvest Levels** OYs would remain the same as in Alternatives 1-5, however the limited entry portion of OYs would be allocated among limited entry vessels as overfished species catch limits (RSQs) and IFQs for non-overfished species. Monitoring of the limited entry fleet would be vessel-by-vessel; monitoring would be substantially increased for the open access and recreational fisheries. If a sector (recreational, open access or limited entry) reached its allocation, that fishery would be closed or severely curtailed to protect the other fisheries. If a species overall OY were reached, further fishing would be prohibited or severely curtailed to prevent overfishing. A portion of the OYs of various species would be reserved for vessels with the lowest catches or catch ratios of overfished species. Any unused OY would be made available to those vessels that had not taken their overfished species allotment. The primary direct effect of this alternative would be a reductions in encounter/bycatch of overfished groundfish to near zero by large no-take marine reserves, reduction of groundfish discard/bycatch due to vessel caps and near 100% retention of all groundfish, and 100% observer coverage of the commercial fleet. Unobserved recreational trips would be the primary source of bycatch. This tool is ranked 1 (highest/most effective) on a scale of 1-2.
- **Vessel trip limits** Vessel trip limits would be relaxed or absent, as each vessel would have individual caps for overfished and other groundfish species. Direct effects expected under this alternative compared to status quo would be substantial reduction and near elimination of regulatory bycatch/discard due to the full retention requirement and requirement to stop fishing when any limit is reached. This tool ranks 4 (no effect) on a scale of 1-4.
- **Vessel Catch Limits** Individual vessel caps in the form of RSQs for overfished stocks and IFQs for other groundfish would be established. All groundfish would be retained. Thus, groundfish bycatch (discard) would be near zero. This tool ranks 1 (most effective) on a scale of a range of 1 - 4 and is substantially more effective at reducing bycatch than trip (retention) limits. However, it would mean that all groundfish captured would be killed, so bycatch mortality would be increased for species that might otherwise survive.

Table 4.3.6. Alternative 6: Reduce groundfish bycatch by large area closures and gear restrictions, RSQs, and IFQs, with 100% retention of groundfish. Relative rank of tools used to reduce bycatch and bycatch mortality. Overfished species in **bold** and emphsis species in *italic*. Species below MSY and subject to precautionary management are noted with (p).

Environment	Species	ABC/OY	Performance standard and OY reserves	Trip limits	Catch limits	Retention requirement	Gear restrictions	Capacity reduction	Time/area management	Monitoring program
			Yes, with OY reserve	Relaxed	Individual vessel RSQ and IFQs	Retain all groundfish	Yes	RSQ & IFQ sales	Areas closed to all groundfish fishing	100% Observer coverage commercial and CPFV, in-season est.
Northern Shelf	**Canary rockfish**	1	1	1	1	1	1-2	1	1	1
	Lingcod	1	1	1	1	1	1-2	1	1	1
	Yelloweye rockfish	1	1	1	1	1	1-2	1	1	1
	Yellowtail rockfish	1	1	1	1	1	1-2	1	1	1
	Arrowtooth flounder	1	1	1	1	1	1-2	1	1	1
	English sole	1	1	1	1	1	1-2	1	1	1
	Petrale sole	1	1	1	1	1	1-2	1	1	1
Southern Shelf	**Boccacio**	1	1	1	1	1	1-2	1	1	1
	Cowcod	1	1	1	1	1	1-2	1	1	1
	Chilipepper	1	1	1	1	1	1-2	1	1	1
Slope	**Darkblotched rockfish**	1	1	1	1	1	1-2	1	1	1
	Pacific Ocean Perch	1	1	1	1	1	1-2	1	1	1
	Dover sole (p)	1	1	1	1	1	1-2	1	1	1
	Sablefish (p)	1	1	1	1	1	1-2	1	1	1
	Shortspine thornyhead (p)	1	1	1	1	1	1-2	1	1	1
	Longspine thornyhead	1	1	1	1	1	1-2	1	1	1
Pelagic	**Widow rockfish**	1	1	1	1	1	1-2	1	1	1
	Pacific whiting	1	1	1	1	1	1-2	1	1	1
Nearshore	*Black rockfish*	1	1	1	1	1	1-2	1	1	1
	Cabezon	1	1	1	1	1	1-2	1	1	1
	Scale	1	1 to 3	1 to 4	1 to 4	1 to 2	1 to 3	1 to 3	1 to 3	1 to 5

- **Gear Regulations** Gear regulation would be actively used to reduce bycatch and bycatch mortality. The use of gears that produce higher bycatch rates or overfished groundfish or other marine species would be phased out. Fishers would be required to adopt gear modifications, use only certified gear types, and/or adopt approved fishing strategies that have been certified to minimize the impacts on marine species and the physical environment. Increased groundfish retention requirements would stimulate vessels to develop gear modifications and fishing strategies that avoid capture of undersized and overfished groundfish. This tool application is ranked 1 (highest) on a scale of 1 - 3.
- **Time/Area Closures** would take the form of large permanent or semi-permanent no-take marine reserves. The placement and size may differ significantly from the other alternatives. For purposes of this analysis, we assume reserves would be patterned after Option 3a of the Council's Phase I Technical Analysis of marine reserves (PFMC 2001). This type of reserve would be tailored to protect overfished species and would set aside 20% of the habitat or biomass with a similar reduction in harvest of the species. Marine reserves would directly reduce bycatch and bycatch mortality of all fish within the closed area. The amount of reduction in bycatch and bycatch mortality resulting from a reserve would be in proportion to the proportion of a species' habitat set aside compared to the total amount of habitat vulnerable to fishing. This would vary depending on the species protected and design of the reserve. The 100% retention requirement would still be the primary means of reducing bycatch outside of reserves. Some indirect benefits to the groundfish resource would likely occur due to reduced disturbance of habitat afforded by reserves. This tool is ranked 1 (most effective) on a scale of 1 - 3.
- **Capacity Reduction** No direct reduction in capacity is considered under this alternative. Tradable IQs would likely result in consolidation of the limited entry fleet (See Alternative 5 discussion on capacity reduction). This tool is assigned a rank of 1 on a scale of 1 - 3.
- **Data Reporting, Record-keeping, and Monitoring** Full (100%) observer coverage and near 100% retention of all groundfish would be required for all limited entry vessels. Sampling/monitoring of the recreational and open access fisheries would be substantially increased under this alternative. Real-time catch reporting would be developed to ensure each fishery stays within its designated catch limits. These controls would have a direct effect of

reducing bycatch compared to other alternatives. Bycatch mortality rates may increase for some species that would survive if released; species in this group include lingcod, sablefish, certain rockfish taken in shallow water, and certain species that lack a swim bladder, as fishers would be required to retain (and thus kill) all groundfish they catch. This tool is ranked 1 (the most highly effective) for its effectiveness in determining total catch on a scale of 1 - 5.

Summary of Impacts on Groundfish Effects of tools used in Alternative 6 on reducing groundfish bycatch, bycatch mortality, and increasing accountability are ranked and summarized in Table 4.3.6. Effects are ranked by in comparison to the other alternatives. Lower numbers indicate a greater effect.

<u>Overfished groundfish</u> OYs for overfished species would be allocated between limited entry, open access and recreational fisheries as under the other five alternatives. The limited entry allocation would be further subdivided and allocated among all vessels as individual restricted species catch limits (RSQs). Each sector would be closed upon reaching its allocation; all sectors would be closed or severely curtailed if the OY for an overfished species were reached. This would effectively keep catches from exceeding the most constraining specified OYs. Catches of other overfished stocks would likely be below their OYs, being constrained by the most constraining stock. Individual shares of canary rockfish and bocaccio would be very small, perhaps substantially less than 100 pounds per year, resulting in severely limited fishing opportunity for many vessels. Many vessels would attempt to purchase additional quota to pursue whatever they perceive to be their best fishing strategies. Large no-take reserves would reduce the likelihood of encountering overfished species, but unless the closed areas covered a species' entire range, encounter/bycatch would occur in open areas, although at a lower rate. The requirement to retain all (or nearly all) groundfish would stimulate . Thus, overfished species bycatch (discarded catch) should be near zero with this alternative due to 100% retention requirement.

Non-certified gears would be phased out; only those gears certified as "low-bycatch" or "low-impact" would be allowed. Such restrictions would likely reduce catch and bycatch of overfished species. No-take reserves would eliminate all fishing for groundfish, reducing bycatch of overfished species and minimizing impact to overfished species habitats.

Unobserved recreational trips would be the primary source of overfished species bycatch.

Emphasis Species The overall harvest policies of Alternative 6 would be the same as the other five alternatives. Limited entry allocations would be subdivided into individual annual vessel catch quotas, which may be larger than the trip limits in Alternatives 1-4 but the same as the IFQs in Alternative 5. Any sector reaching its allocation of a non-overfished species would be curtailed or closed, depending on the species and whether other sectors' allocations were threatened. Any unused allocations would be made available to those vessels that had not taken their overfished species allotments. IFQ shares would have effects similar to Alternative 5. However, the establishment of large no-take reserves more restrictive gear requirements could make it more difficult for vessels to take their IFQs. Also, the most constraining RSQ limits (for canary and bocaccio rockfish) would increase the likelihood that substantial amounts of target species quotas would not be taken. This alternative differs from Alternative 5 in that all groundfish must be retained (only overfished groundfish must be retained in Alternative 5). The primary direct effects of this alternative would be reduced groundfish discard/bycatch and likely reduced catches and catch rates of many target groundfish species as well. The no-take reserves and gear restrictions could result in intensified fishing with certified gears and methods in open areas. Catches of all groundfish species would be eliminated within the reserve boundaries; over time, abundance of target groundfish species could increase around the edges of reserves as fish migrate outward.

4.3.1.6.1 Effects of Harvest Level Specifications under Alternative 6

OYs would remain the same as in *status quo,* however distributions of available OY would be broken down into caps for each fishing vessel with in-season monitoring of caps. Performance standards and OY reserves are required by this alternative. Harvest caps cannot be exceeded by individual vessels and overfished species must be retained. Shares may be purchased in order to continue fishing. This alternative ranks 1 on a scale of 1 - 3 in terms of performance standards and OY reserves.

<u>Overfished Groundfish</u> OY for overfished species would then be broken down into caps or RSQs for each fishing vessel with in-season monitoring of caps. When OY is reached, further fishing would be prohibited or severely curtailed. A reserve of various species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Any unused OY would be made available to those vessels that had not taken their overfished species allotment.

The impacts of application of this tool within Alternative 6 is similar to the impacts described under Alternative 5. Small individual shares of RSQ for some species like canary rockfish and bocaccio would have to be purchased and sold to consolidate enough share to fish under certain strategies. The primary direct effect of this Alternative would be reductions in bycatch due to strict caps and 100% retention of all groundfish. Thus, overfished species bycatch (discarded catch) should be near zero with this alternative due to 100% retention requirement. Unobserved recreational trips would be the primary source overfished species bycatch.

<u>Emphasis Species</u> Objectives for optimum yield would remain the same as in *Status quo*. OY for overfished species only would then be broken down into caps for each fishing vessel with in-season monitoring of caps. When OY is reached, further fishing would be prohibited or severely curtailed. A reserve of various species would be set aside for vessels with the lowest catches or catch ratios of overfished species. Any unused OY would be made available to those vessels that had not taken their overfished species allotment. Tradable IFQ shares would have impacts similar to Alternative 5 in that shares are likely to be bought and sold to consolidate fishing strategies. This alternative differs from Alternative 5 in that all groundfish must be retained. The primary direct effect of this Alternative would be reductions in bycatch due to strict caps and 100% retention of all groundfish

4.3.1.6.2 Effects of Trip Limits under Alternative 6

Vessel trip limits would be relaxed or absent, as each vessel would have an individual RSQ and IFQ caps on groundfish. Essentially the trip limit would take the form of an individual vessel annual quota. Because trip limits would not be used, the application of this tool is given a rank of 1 (most effective).

<u>Overfished Groundfish</u> Vessel trip limits would be relaxed or absent, as each vessel would have an individual cap on

overfished species. Direct effects expected under this alternative compared to status quo would be a reduction in regulatory induced discard of overfished species due to relaxed trip limits and 100% retention requirement.

Emphasis Species Vessel trip limits would be relaxed or absent, as each vessel would have an individual cap on other groundfish. Direct effects expected under this alternative compared to status quo would be a reduction in size related and market induced discard of other groundfish due to the 100% retention requirement.

4.3.1.6.3 Effects of Catch Limits under Alternative 6

Individual vessel caps for overfished stocks would be established with this Alternative. 100% of all groundfish would be retained. Bycatch and bycatch mortality would therefore be significantly reduced. compared to other alternatives not using individual quotas and to Alternative 5. Vessel catch limits in the form of RSQs and IFQs rank 1 (most effective) on a scale of 1 - 4.

Overfished Groundfish The impacts to overfished groundfish would be similar to those under Alternative 5. The 100% retention requirement would and 100% observer coverage would reduce bycatch of overfished species to near zero. Regulatory induced bycatch would be eliminated. See discussion above under Alternative 5.

Emphasis Species Individual transferable quotas (IFQs) would be established for other groundfish with this alternative. This application of catch limits in this alternative be similar to Alternative 5. Impacts would be different due to the 100% retention requirement and 100% observer coverage. Bycatch of other groundfish would be near zero and regulatory and market related bycatch would be eliminated.

4.3.1.6.4 Effects of Gear Restrictions under Alternative 6

Gear restrictions would be applied more fully than *status quo.* This application of gear restrictions is given a rank of 1 or 2 on a scale of 1 - 3. All gears would have to be certified as “low bycatch” or “low impact” under this alternative. This would effectively reduce all bycatch below Alternatives 1-4. In the short term, it would likely be more effective than Alternative 5 also, as all vessels would be required to use certified gears. In the long term, however, the incentives and flexibility to experiment with various gear modifications under Alternative 5 would likely lead to continual improvement in bycatch avoidance and minimization.

Overfished Groundfish Fishers would be required to fish only with gears that have been certified to reduce bycatch, and vessels must stay within RSQs. Unless opportunities for gear experimentation were provided, the best gears at reducing bycatch might not be identified. Some unseen mortality could take the form of overfished species caught but excluded by fishing gears. The bycatch mortality of escaping fish is unknown.

Emphasis Species Fishers would be required to fish only with gears that have been certified to reduce bycatch, and vessels must stay within IFQs. The 100% retention requirement may be very challenging for some fishers seeking ways of selecting against un-marketable fish. For example, fishers may increase mesh-size to in an attempt to eliminate most of the undersized fish. Reduction of catch of unwanted fish would contribute to the reduction in bycatch. However, unseen mortality could take the form of undersized fish caught but excluded by the gear. Impacts of direct and delayed mortality of escaping fish is poorly understood.

4.3.1.6.5 Effects of Time/Area Management under Alternative 6

Time/area management would take the form of permanent or semi-permanent marine reserves. The placement and size may differ significantly from all of the other alternatives. We assume these areas to set aside at least 20% of the habitat or biomass of the overfished species, and that biomass available for harvest would be similarly reduced. MPAs would have more permanency than RCAs described in previous alternatives. Areas proposed by this alternative would be closed to all fishing. This tool ranks 1 on a scale of 1-3.

Overfished Groundfish Extensive habitat and species distribution mapping would be needed in order to define new boundaries for overfished species. Because there are several overfished species, the proportion of area set aside to total fishable area may be larger or smaller than 20%. Impacts will be difficult to determine until the location and composite size of these areas are determined.

No-take marine reserves directly reduce bycatch and bycatch mortality of overfished species within the closed area. The amount of reduction in bycatch and bycatch mortality of an overfished species due to a reserve would be in proportion to the amount of habitat set aside compared to the total amount of its habitat vulnerable to fishing. Movement of fish into and out of reserves may confound efforts to protect mobile/migratory species. If catch levels were not reduced, effort would likely shift to adjacent areas, increasing impacts of fishing outside the boundaries. Bycatch and bycatch mortality could increase unless catch were reduced in proportion the area set aside.

Studies of groundfish trawl fishery of the coast of British Columbia suggest fishing changes species composition and spatial structure of the fishery. Movement of trawlers through redistribution of effort and fish movement appears to reduce vulnerability (Walters and Bonfil 1999). The authors suggested use of individual effort quotas (rather than catch) and use of carefully placed protected areas to protect sensitive stocks.

Impacts of various MPA and no-take reserve options for bocaccio, Pacific ocean perch, and lingcod are described in the Phase I Council report on marine reserves (PFMC 2001). Reserves appear to reduce rebuilding time, similar to that which could be achieved by reducing the exploitation rate. An additional benefit would be reduced habitat impacts. Some loss of fishing opportunity would occur with reserves that included a reduced harvest rate (option 3a in the Phase I document).

The 100% retention requirement would still be the primary means of reducing overfished species bycatch. Some indirect benefits to the overfished species would likely occur due to reduced disturbance of habitat afforded by a no-take reserve.

<u>Emphasis Species</u> Time/area management would include establishment of permanent or semi-permanent no-take marine reserves. The placement and size may differ significantly from all of the other alternatives. Such reserves would directly reduce bycatch and bycatch mortality of other groundfish species within the closed area. The amount of reduction in bycatch of any particular groundfish species due to a no-take reserve would be in proportion to the vulnerable population inside and outside the boundaries.

The 100% retention requirement would be the primary means of reducing discard/bycatch outside of marine reserves.

4.3.1.6.6 Effects of Capacity Reduction under Alternative 6

No direct reduction in capacity is applied under Alternative 6. Some level of fleet consolidation would occur as market forces would favor more efficient vessels. Thus, capacity reduction would be an indirect effect of this approach rather than an intentional or specified result. However, capacity reduction would occur in all sectors, not just the trawl fleet as in Alternative 2. Therefore, this tool is ranked 1 on a scale of 1-3.

<u>Effects on Overfished Groundfish</u> Some capacity reduction may occur if vessel owners sell RSQ and IFQ shares and elect to fish in a non-groundfish fishery. Capacity reduction accomplished through RSQ and IFQ sales could have a positive direct reducing bycatch of overfished species. Some vessel owners may also chose to fish in other fisheries and hold onto RSQ and IFQ shares. To the degree shares were unused, catch, bycatch, and bycatch mortality would be reduced.

<u>Effects on Emphasis Species</u> See discussion above.

4.3.1.6.7 Effects of Data Reporting, Record-keeping, and Monitoring under Alternative 6

Alternative 6 would require 100% observer coverage of all commercial groundfish vessels and increased monitoring of recreational groundfish fisheries. Under Alternative6, observer coverage would be redesigned to ensure that each commercial vessel's bycatch of overfished groundfish species is accurately assessed and recorded, with records available almost immediately for management purposes. Logbooks would not be required or used. Vessels reaching any catch limit of overfished species (or other restricted species catch limit) would be required to stop fishing until they obtain additional quota. This would be until the beginning of the next year unless they purchased quota from a shareholder. A program to monitor quota transfers would be required.

The catch reporting, record keeping, and monitoring program established by Alternative 6 would be similar to Alternative 5 with increased monitoring of open access and recreational sectors. This would have a direct effect of reducing encounter/ bycatch of overfished species compared to the Alternatives 1-4. Discard/bycatch would also be reduced in the commercial fisheries as fishers would be required to retain nearly all groundfish and all fish would count towards their individual catch limits. This tool is ranked 1 (most effective) on a scale of 1 - 5 for its effectiveness in reducing groundfish bycatch.

4.3.2 Impacts on Other Relevant Fish, Shellfish, and Squid

<u>Bycatch of Pacific Halibut</u>
Pacific halibut is a highly prized fish targeted by commercial, recreational and tribal fisheries along the West Coast. Directed halibut fishing is managed through a combination of gear, season, area and size restrictions. Only specified hook-and-line gear (see below) may be used to fish for halibut, and only halibut taken with hook-and-line gear may be retained. (The only exception is for tagged halibut, which may be retained regardless of gear, size or area. However, if a tagged halibut is retained, the tag must be returned to the *INTERNATIONAL PACIFIC HALIBUT COMMISSION* (*IPHC*).) The retained fish may only be sold if taken in authorized halibut fisheries, otherwise it may be only be kept for personal consumption. A minimum size limit also applies throughout the range of the species; only halibut over 82 cm (32 in) may be retained in any fishery. Again, the exception is that tagged halibut of any size may be retained.

During specific annual seasons/areas, legal-sized halibut may be retained and landed in recreational, commercial setline, and tribal setline fisheries. An allowance is also made for commercial salmon trollers, who are authorized to retain limited amounts of halibut caught while fishing for salmon. Any halibut taken with other gear, outside those seasons/areas, or under legal size, is considered bycatch and must be returned to the sea. Pacific halibut (unless tagged) may not be legally retained by trawl gear at any time and all that are caught are bycatch. Depending on the method of capture and fishing operations, many halibut may survive if handled gently and returned to the sea quickly. These regulations are established to attain but not exceed the estimated total allowable harvest for the year.

The bycatch of Pacific halibut off the West Coast has relatively little impact on the overall status of the population, but it does affect the total allowable harvest for directed West Coast halibut fisheries, including groundfish fisheries authorized to retain halibut. Halibut are migrants from northern waters off Canada and Alaska, where the bulk of the population resides. Little, if any, spawning occurs off the West Coast. Each year, the estimated bycatch of legal-sized fish off the West Coast is subtracted from the estimated yield to determine the allowable harvest for target fisheries. Consequently, the amount of bycatch has a direct impact on the recreational and setline fisheries for halibut.

In some past years, the estimated bycatch of halibut in groundfish fisheries has been substantial, based on limited observations of the bottom trawl fishery. Pacific halibut are most frequently caught by bottom trawls operating in the 100-300 fathom depth range off Washington and Oregon, but also are taken at shallower depths on the shelf and off northern California. Few halibut are taken by midwater trawl gear.

Bycatch is estimated as a function of halibut catch rate and effort fished for a particular time, area, depth, and target species category. Some of these categories have much higher catch rates than others and could be termed "halibut hot spots." Much of the distribution of Pacific halibut falls within the MPAs (groundfish RCAs). Therefore, bycatch is believed to have been reduced from previous years because bottom trawl effort is curtailed in these areas.

Impacts of the Alternatives Compared to Alternative 1 (status quo/no action), bycatch of Pacific halibut would not likely change much under Alternatives 2 and 3. The recent reductions in halibut bycatch would be maintained, to the extent that depth restrictions (MPAs/RCAs) for on-bottom groundfish fishing is not expanded under these alternatives. However, this reduction could be partially offset if effort were concentrated in an area or time when halibut were also concentrated. For example, observed halibut bycatch rates by bottom trawl fisheries during the late 1990s were higher during the January through August period than during September through December. Therefore, if the fishing season (and effort) under Alternative 3 were concentrated during January through August, then halibut bycatch and bycatch mortality could increase.

By further reducing the "race for fish," Alternatives 4, 5 and 6, increase vessels' flexibility to practice bycatch avoidance techniques. These alternatives may provide greater awareness and opportunity to conduct fishing operations in a manner that could lead to reduced bycatch and bycatch mortality of halibut. The desire to avoid halibut bycatch is likely comparable to the desire to avoid bycatch of overfished species, so halibut bycatch would tend to be reduced, at least in the same direction if not magnitude, as bycatch for overfished species. In addition, halibut bycatch under Alternative 6 would likely be reduced to the extent that closed areas are placed in areas where halibut are concentrated. However, bycatch would be increased to the extent that greater fishing effort on bottom occurred in halibut "hot spots" because of closed areas elsewhere. Incentives for gear modifications and changes to fishing practices to remain within groundfish bycatch caps under these alternatives could increase or decrease halibut bycatch, depending on the modifications implemented.

Although not expressly included in the alternatives, Pacific halibut could be treated like a groundfish for purposes of applying restricted or prohibited species caps (Alternatives 5 and 6) or allowing vessels with low halibut bycatch to access a groundfish OY reserve (Alternatives 4 and 5). If a cap were applied, then halibut bycatch would be reduced accordingly. If Alternative 6 were modified to require full retention of halibut (as for groundfish), then discard/bycatch would be eliminated.

Summary Currently, trawl bycatch and bycatch mortality of Pacific halibut off the West Coast are primarily a function of the amount of bottom fishing effort in times and areas where halibut occur. Reducing trawl effort in these areas reduces bycatch, and increasing effort increases bycatch. To the extent that fishing effort patterns change with respect to halibut distribution and abundance, the impact of the alternatives will increase or decrease halibut bycatch. In addition, Alternatives 4, 5 and 6 would increase monitoring and reporting; improved halibut bycatch information would ultimately contribute to bycatch reduction.

Halibut bycatch in the groundfish fisheries may be more effectively reduced through the application of certain fisheries management tools than through the proposed alternatives. For example, allowing retention of Pacific halibut by the trawl fishery and by other fisheries outside of currently allowed seasons or areas could substantially reduce discard/bycatch. Similarly, gear modification through the use of halibut bycatch reduction devices, which have been used in trawl fisheries off Alaska, may be beneficial, although potentially costly, for reducing bycatch off the West Coast. Such regulatory changes would primarily be based on social and economic considerations that are not explicitly addressed in the alternatives. They could be included in any of the alternatives.

4.3.3 Impacts on Protected Species

This section examines interactions between protected species and groundfish fisheries under the programmatic alternatives being considered consideration in this EIS. As a point of clarification, interactions and incidental catches are different than bycatch. <u>Interactions</u> and <u>incidental catches</u> involve fishing gears and marine mammals, turtles and birds, while bycatch consists of discards of fish. Turtles, although defined as fish in the Magnuson-Stevens Act and thus technically bycatch, are included in this section because of their protected status (NMFS 1998).

4.3.3.1 Impacts on Pacific Salmon

Pacific salmon are among the most highly prized species targeted by commercial, recreational and tribal fisheries on the West Coast. Directed salmon fishing is managed through a combination of catch limit, gear, season, area, size and fin-clip restrictions. Pacific coast fisheries in Council-managed waters (3-200 nm offshore) are directed toward and harvest primarily chinook (king) salmon and coho (silver) salmon. Small numbers of pink salmon are also harvested, especially in odd-numbered years. There are no directed fisheries for other Pacific salmon species, and they occur rarely (sockeye) or in very limited numbers (steelhead and chum) in Council-managed harvests.

Several salmon stocks on the West Coast are listed as threatened or endangered under the ESA. Salmon caught in trawl nets are classified as prohibited species, and therefore, salmon captured by groundfish trawl fisheries and brought aboard must be returned to the sea as soon as practicable and with minimal injury (after allowing for sampling by an observer).

Table 4.3.7. Salmon bycatch in the Pacific whiting fisheries, 1995-2002. At-sea data from NMFS Observer Data; shorebased data from ODFW.

At-sea Whiting Sector	1995	1996	1997	1998	1999	2000	2001	2002
Chinook Salmon	11578	1446	1,398	1477	4391	6260	2,568	1679
Other Salmon 4/	4,414	279	924	27	802	115	770	173
Total Salmon	15992	1725	2,322	1,504	5,193	6,375	3,338	1,852
Percent Chinook	72.4	83.8	60.2	98.2	84.6	98.2	76.9	90.7
No. Chinook/ mt	0.1133	0.013	0.012	0.012	0.038	0.0546	0.0272	0.0267
Shorebased Sector								
Chinook Salmon	2954	674	1,558	1,699	1,696	3,306	2,627	1,062
Other salmon	18	0	3	14	16	24	370	86

Relatively few salmon are incidentally taken during commercial fishing operations for groundfish. As a result of the spatial/ temporal overlap between chinook salmon distribution and the midwater trawl fishery for whiting, most salmon bycatch is taken when fishing for Pacific whiting (Table 4.3.7). Salmon are most often present in the water column, rather than near the sea floor, and midwater trawl gear is primarily used to capture whiting. In the at-sea fishery, the trawl nets are emptied on the deck, and salmon can be removed from the catch and returned to the sea quickly. Nearly all vessels in the shore-based fishery empty their trawls directly into the hold, typically filled with refrigerated seawater, where the entire catch remains for several hours until offloaded at shore-based processing plants. Through Exempted Fishing permits (EFPs), these vessels have been exempted from requirements to sort all of the catch; all must be retained and delivered so all salmon and other species can be observed and tallied at the plant. All retained salmon must be relinquished to the appropriate State.

The 1992 *Biological Opinion* (BO) analyzing the effects of the Pacific Coast groundfish fishery on salmon stocks listed under the ESA established limits to bycatch of chinook salmon. Currently the limit is set at 0.05 chinook salmon per metric ton of Pacific whiting, with an associated total catch of 11,000 chinook for the coastwide Pacific whiting fishery. This BO was subsequently reviewed and the allowable chinook catch level reaffirmed in 1993, 1996 and 1999,

The 1992 BO also requires the Council to provide for monitoring of salmon bycatch in the midwater trawl fishery for whiting, but not in the bottom trawl fishery for groundfish.

Currently, this monitoring requirement is based on not jeopardizing the existence of listed salmon species, including the Snake River fall chinook, lower Columbia River chinook, upper Willamette River chinook, and Puget Sound chinook. At present, the at-sea whiting fishery has 100% observer coverage. In recent years, a cooperative (voluntary) effort between the fishing industry and management agencies has been implemented to facilitate observer coverage and collect information on directed whiting landings at shoreside processing plants. Participating vessels are issued *EXEMPTED FISHING PERMITS* (EFPs), which allow vessels to land unsorted catch at designated processing plants. Permitted vessels are not penalized for landing prohibited species, including Pacific salmon, nor are they held liable for overages of groundfish trip limits. In 2003, 99% of the whiting catch by the shoreside fishery was landed under an EFP.

Impacts of the Alternatives In general, the impacts of the alternatives on salmon bycatch is relatively minor. Compared to Alternative 1, bycatch of Pacific salmon in the whiting fisheries would not likely change much under Alternatives 2, 3, and 4. Alternatives 5 and 6 would substantially increase observer coverage and thus provide a more comprehensive understanding of salmon bycatch. Improved bycatch information could lead to some improvements. However, given the voluntary efforts by whiting fishers to avoid salmon bycatch in these fisheries, little reduction would likely occur in these fisheries.

4.3.3.2 Impacts on Seabirds

Interactions between seabirds and fishing operations are widespread and have led to conservation concerns in many fisheries throughout the world. Abundant food in the form of offal (discarded fish and fish processing waste) and bait attract birds to fishing vessels. Of the gear used in the groundfish fisheries in the North Pacific, seabirds are occasionally taken incidentally by trawl and pot gear, but they are most often taken by longline gear. Around longline vessels, seabirds forage for offal and bait that has fallen off hooks at or near the water's surface, and are attracted to baited hooks near the water's surface, during the setting of gear. If a bird becomes hooked while feeding on bait or offal, it can be dragged underwater and drowned.

Besides entanglement in fishing gear, seabirds may be indirectly affected by commercial fisheries in various ways. Change in prey availability may be linked to directed fishing and the discarding of fish and offal. Vessel traffic may affect seabirds when it occurs in and around important foraging and breeding habitat and increases the likelihood of bird strikes. In addition, seabirds may be exposed to at-sea garbage dumping and the diesel and other oil discharged into the water associated with commercial fisheries.

In the Pacific Coast groundfish fisheries, groundfish observers collect information on interactions between seabirds and groundfish fisheries. Catcher-processors and motherships participating in the Pacific whiting fishery have had full observer coverage since the mid-1970s. The non-whiting portion of the groundfish fishery has had observer coverage only since the fall of 2001. Between September 2001 and October 2002, approximately 10% of the coastwide limited entry trawl landed weight and 30% of the limited entry fixed gear landed weight was observed.

The incidental take of seabirds by the at-sea whiting fleet is rare and infrequent. The species that have been taken by the at-sea whiting fleet include black-footed albatross, northern fulmar, and unidentified puffin. In the limited entry groundfish fisheries, few interactions with seabirds have been observed (Table 4.3.8).

Table 4.3.8. Interactions between seabirds and the Pacific Coast groundfish fisheries documented by West Coast Groundfish Observers between September 2001 and October 2002.

Species	Gear Type	Type of Interaction
Unidentified Gull (*Larus species)*	Trawl	1 Individual Taken
Unidentified Seabird	Trawl	4 Individuals Taken
Short-tailed Albatross (*Phoebastria albatrus*)	Longline and Trawl	Feeding on Discard
California Brown Pelican (*Pelecanus occidentalis californicus*)	Rod and Reel	Feeding on Discard
Marbled Murrelet (*Brachyramphus marmoratus*)	Trawl	Landed on Deck
Black-footed Albatross (*Phoebastria nigripes*)	Trawl, Longline, and Pot	Feeding on Discard
Leach's storm-petrel *(Oceanodroma leucorhoa*)	Trawl	Landed on Deck
Cassin's auklet *(Ptychoramphus aleuticus)*	Trawl	Landed on Deck
Pigeon guillemots *(Cepphus columba*)	Pot	Feeding on Discard
Laysan albatross *(Phoebastria immutabilis)*	Pot	Feeding on Discard
Unidentified Cormorant (*Phalacrocorax species)*	Rod and Reel	Feeding on Discard
Unidentified Storm Petrel (*Oceanodroma species*)	Longline	Landed on Deck
Unidentified Shearwater (*Puffinus species*)	Pot	Feeding on Deck

In response to increased national concern about the incidental take of seabirds, NMFS, USFWS, and the Department of State collaborated in 2001 to develop the U.S. *National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries*. The purpose of this plan is to provide national-level policy guidance on reducing the incidental take of seabirds in U.S. longline fisheries and to require NMFS, in cooperation with USFWS, to conduct an assessment of all U.S. longline fisheries to determine whether an incidental take problem exists. Using the West Coast Groundfish Observer Program's first year of data, NMFS drafted a preliminary assessment of seabird interactions with the groundfish longline fleet in 2003. There were no incidental takes of seabirds by longline vessels documented by NMFS groundfish observers during September 2001 to October 2002; however, a number of interactions between seabirds and longline vessels were observed (see Table 4.3.8). Additionally, this National Plan of Action further requires NMFS, in cooperation with USFWS, to work through the regional fishery management council process in partnership with longline fishery representatives to develop and implement mitigation measures in those fisheries where the incidental take of seabirds is a problem. Therefore, NMFS will continue to work with the USFWS to better understand the interactions between seabirds and the groundfish fisheries and evaluate the need for seabird incidental take mitigation and management measures.

In order to predict the effects of the bycatch reduction alternatives on Pacific Coast seabird populations, it is important to have knowledge of the distribution, intensity, and duration of fishing effort associated with the groundfish fisheries. This information is currently unavailable for the groundfish fleet, but additional sources information should soon become available.

As of January 1, 2004, all vessels are required to carry Vessel Monitoring System (VMS) equipment while fishing for groundfish. VMS equipment identifies precise vessel location information. Additionally, information on the distribution of fishing effort is being developed as part of an Essential Fish Habitat Risk Assessment scheduled to be available in the spring of 2004. Because of the temporal and spatial overlap between seabird populations and groundfish fishing effort, projected harvest levels and proposed area closures will be used as a proxy for predicting the bycatch reduction alternatives on seabird populations.

Incomplete or Unavailable Information As required by CEQ's NEPA implementing regulations, any time there is incomplete or unavailable information, the federal agency must not only identify that such information is unavailable, but also make an assessment of the importance of that information and what would be the agency's evaluation of the predicted environmental impacts (i.e., best professional judgement) (40

CFR Part 1502.22). Accordingly, NMFS acknowledges that information on the distribution, intensity, and duration of fishing effort is incomplete with no current means of accurately tracking this information. This information is important in order to quantify fishing effort and predict the potential risks of interactions with seabirds. Thus, the following paragraphs shall present a best professional judgement (i.e., qualitative assessment) of the predicted environmental impacts of the alternatives on seabirds.

Under Alternative 1, it is predicted that interactions between the Pacific Coast groundfish fishery and seabirds would be similar to the seabird/fishery interactions during the 2002/2003 groundfish fishery. Based on West Coast Groundfish Observer data, the combined use of trip limits, gear restrictions, and area closures has resulted in few interactions between the groundfish fleet and seabirds (Table 4.3.8). Seabirds may benefit from the temporal and/or spatial distribution of fishing effort associated with trip limit management and area closures, provided that these management measures do not concentrate fishing effort in areas important to seabird foraging and/or breeding. As more information is gathered on seabird interactions with the groundfish fleet, gear restrictions and area closures may be modified to reduce interactions with seabirds.

Under Alternative 2, the number of commercial groundfish trawl vessels would be a reduced to 50% or 2000 levels. This reduction in fleet size, paired with gear restrictions and area closures, would likely reduce the trawl fleet’s interactions with seabirds. Additionally, by increasing the trip limits for various groundfish species, any “race for fish” should be further reduced, potentially allowing fishing behavior to be modified to avoid interactions with seabirds.

Alternative 3 would implement a shorter fishing season, as opposed to the current year-round groundfish fishery, as well as gear restrictions and trip limits designed to discourage fishing in certain areas. Under this alternative, the number of vessels would not be reduced, but fishing would be concentrated in shorter seasons. If fishing activities were concentrated into seasons where there was limited seabird activity along the Pacific Coast, the number of interactions may be reduced under Alternative 3. However, if fishing were to be concentrated into seasons important for seabird foraging and/or breeding, interactions with seabirds may increase under Alternative 3. During closed periods, all interactions with seabirds would be greatly reduced. The overall effect of Alternative 3 is difficult to predict but it likely depends on the seasonality of the concentrated groundfish fishery.

Alternative 4 would continue the use of trip limits but with additional restrictions on the amount of groundfish catch that can occur. The objective of Alternative 4 is to provide extended groundfish fishing opportunities for vessels with low rates or low amounts of groundfish bycatch. The effects on seabird/ fishery interactions due to additional catch restrictions are difficult to predict, however, it is likely that they would be similar to those under Alternative 3.

Alternative 5 would establish individual vessel groundfish catch quotas (IFQs and RSQs) as a means to mitigate groundfish bycatch and would relax some gear restrictions to encourage fishers to develop individual groundfish bycatch avoidance techniques. While establishment of groundfish quotas may be an effective way to limit bycatch of groundfish species, IQs alone would not directly reduce interactions between seabirds and the Pacific Coast groundfish fleet. However, it is likely that the establishment of individual groundfish catch quotas would result in further reducing the number of trawl vessels. IQs should also provide a much greater opportunity for vessels to choose when and where they will fish. Additionally, an IQ program may require 100% observer coverage to ensure effectiveness, therefore, the level of information on seabird interactions (as well as seabird distribution) would likely increase substantially. As more is understood about the interactions between groundfish vessels and seabirds along the Pacific Coast and as this information is passed along to fishers, Alternative 5 has the potential to reduce interactions with seabirds.

Under Alternative 6, no-take marine reserves and vessel caps would be used to mitigate bycatch by groundfish vessels. Marine reserves would likely be designed to reduce or prevent incidental take of overfished groundfish species, although they could also be designed to reduce bycatch of other species. Should these areas of reduced fishing coincide with areas important for foraging and breeding seabirds, then Alternative 6 may be useful in reducing the potential for seabird/fishery interactions. Conversely, if these restricted areas cause fishing effort to be concentrated in areas used by seabirds, then Alternative 6 may increase the potential for seabird/fishery interactions. However, the added implementation of groundfish quotas would likely result in a smaller fleet and more cautious fishing strategies. Therefore, Alternative 6 is predicted to result in reduced seabird/fishery interactions compared to Alternatives 1, 2, and 3 and similar to Alternative 5. As more information is gathered on seabird interactions with the groundfish fleet, marine protected areas may be modified to reduce interactions with seabirds.

As more information about the spatial and temporal overlap of groundfish fisheries and seabird populations along the Pacific Coast is gathered, a more comprehensive understanding of seabird/fishery interactions is possible. If it is found that mitigating the effects of the Pacific Coast groundfish fishery on seabirds is necessary, additional management measures, such as seabird deterrents (i.e., streamer lines), discharging offal opposite the hauling station, and reducing fishing activity in areas and/or during seasons important for seabird breeding and/or foraging, may be required under any of the alternatives.

4.3.3.3 Impacts on Marine Mammals

The marine mammal species accounts presented here are taken primarily from the most recent Stock Assessment Reports (Carretta *et al.* 2001) prepared by NMFS as required by the Marine Mammal Protection Act (MMPA).

Table 4.3.9. Marine mammal species that occur off the West Coast that are, or could be, of concern with respect to potential interactions with groundfish fisheries.

	Scientific Name	ESA Status
Pinnipeds		
California sea lion	*Zalophus californianus*	
Pacific harbor seal	*Phoca vitulina richardsi*	
Northern elephant seal	*Mirounga angustirostris*	
Guadalupe fur seal	*Arctocephalus townsendi*	T
Northern fur seal	*Callorhinus ursinus*	
Northern or Steller sea lion	*Eumetopias jubatus*	T
Sea otters		
Southern	*Enhydra lutris nereis*	T
Washington	*Enhydra lutris kenyoni*	
Cetaceans		

Minke whale	*Balaenoptera acutorostrata*
Short-finned pilot whale	*Globicephala macrorhyncus*
Gray Whale	*Eschrichtius robustus*
Harbor porpoise	*Phocoena phocoena*
Dall's porpoise	*Phocoenoides dalli*
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*
Short-beaked common dolphin	*Delphinus delphis*
Long-beaked common dolphin	*Delphinus capensis*

The groundfish fisheries have been determined not to jeopardize any marine mammal species. None of the alternatives under consideration is expected to significantly impact any marine mammal.

Table 4.3.10. Cetaceans that are present but not likely to interact with groundfish fisheries or that have not been documented having had interactions in observed groundfish fisheries.

	Scientific name	ESA Status
Bottlenose dolphin	*Tursiops truncatus*	
Striped Dolphin	*Stenella coeruleoalba*	
Sei whale	*Balaenoptera borealis*	E
Blue whale	*Balaenoptera musculus*	E
Fin whale	*Balaenoptera physalus*	E
Sperm whale	*Physeter macrocephalus*	E
Humpback whale	*Megaptera novaeangliae*	E
Bryde's whale	*Balaenoptera edeni*	
Sei whale	*Balaenoptera*	E
Killer whale	*Orcinus orca*	
Baird's beaked whale	*Berardius bairdii*	
Cuvier's beaked whale	*Ziphius cavirostris*	
Pygmy sperm whale	*Kogia breviceps*	
Risso's dolphin	*Grampus griseus*	
Striped dolphin	*Stenella coeruleoalba*	
Northern right-whale dolphin	*Lissodelphis borealis*	

California Sea Lion - Incidental mortalities of California sea lions have been documented in set and drift gillnet fisheries (Carretta *et al.* 2001; Hanan *et al.* 1993). Skippers logs and at-sea observations have shown that California sea lions have been incidentally killed in Washington, Oregon, and California groundfish trawls and during Washington, Oregon, and California commercial passenger fishing vessel fishing activities (Carretta *et al.* 2001). Total human-caused mortality (1,352 sea lions) is less than the 6,591 sea lions allowed under the Potential Biological Removal formula (Carretta et al. 2001).

Harbor Seal - Combining mortality estimates from California set net, northern Washington marine set gillnet, and groundfish trawl results in an estimated mean mortality rate in observed groundfish fisheries of 667 harbor seals per year along Washington, Oregon, and California (Carretta et al. 2001).

Northern Elephant Seal - There are no recent estimated incidental kills of Northern elephant seals in groundfish fisheries along Washington, Oregon, and California, however they have been caught in setnet fisheries (Carretta et al. 2001).

Guadalupe Fur Seal - There have been no U.S. reports of mortalities or injuries for Guadalupe fur seals (Cameron and Forney 1999; Julian 1997; Julian and Beeson 1998), although there have been reports of stranded animals with net abrasions and imbedded fish hooks (Hanni et al. 1997).

Northern Fur Seal - There were no reported mortalities of northern fur seals in any observed fishery along the West Coast of the continental U.S. during the period 1994-1998 (Carretta *et al.* 2001), although there were incidental mortalities in trawl and gillnet fisheries off Alaska (Angliss and Lodge 2002).

Eastern Stock Steller Sea Lion - These have been observed taken incidentally in WA/OR/CA groundfish trawls and marine set gillnet fisheries (Angliss and Lodge 2002). Total estimated mortalities of this stock (44) is less than the 1,396 Steller sea lions allowed under the Potential Biological Removal formula (Angliss and Lodge 2002).

Southern Sea Otter - During the 1970s and 1980s considerable numbers of sea otters were observed caught in gill and trammel entangling nets in central California. During 1982 to 1984, an average of 80 sea otters were estimated to have drowned in gill and trammel nets (Wendell *et al.* 1986). This was projected as a significant source of mortality for the stock until gill nets were prohibited within their feeding range. More recent mortality data (Pattison *et al.* 1997) suggest similar patterns during a period of increasing trap and pot fishing for groundfish and crabs (Estes *et al.* In Press). This elevated mortality appears to be the main reason for both sluggish population growth and periods of decline in the California sea otter population (Estes *et al.* In Press).

Sea Otter (Washington Stock) - Gillnet and trammel net entanglements were a significant source of mortality for southern sea otters (Wendell *et al.* 1986) and some sea otters were taken incidentally in setnets off Washington (Kajimura 1990). Evidence from California and Alaska suggests that incidental take of sea otter in crab pots and tribal set-net fisheries may also occur. Sea otters are also quite vulnerable to oil spills due to oiled fur interfering with thermoregulation, ingested oil disintegrating the intestinal track, and inhaled fumes eroding the lungs (Richardson and Allen 2000).

Harbor porpoise - Harbor porpoise are very susceptible to incidental capture and mortalities in setnet fisheries (Julian and Beeson 1998). Off Oregon and Washington, fishery mortalities of harbor porpoise have been recorded in the northern Washington marine set and drift gillnet fisheries (Carretta *et al.* 2001). However, these fisheries have largely been eliminated.

Dall's porpoise - Observers document that Dall's porpoise have been caught in the California, Oregon and Washington domestic groundfish trawl fisheries (Perez and Loughlin 1991) but the estimated annual take is less than two porpoise per year.

White-sided Dolphin - Observers have documented mortalities in the California, Oregon, and Washington groundfish trawl fisheries for whiting (Perez and Loughlin 1991). The total estimated kill of white-sided dolphins in these fisheries averages less than one dolphin per year (Carretta *et al.* 2001).

Risso's Dolphin - There have been no recent Risso's dolphin moralities in West Coast groundfish fisheries (Carretta *et al.* 2001), although Reeves *et al*.(2002) report that Risso's are a bycatch in some longline and trawl fisheries.

Common Dolphin - Common dolphin mortality has been estimated for set gillnets in California (Julian and Beeson 1998); however, the two species (short-beaked and long-beaked) were not reported separately. Reeves *et al*.(2002) relate that short-beaked common dolphins are also a bycatch in some trawl fisheries.

Short-finned Pilot Whale - Total human-caused mortality (3) of this species is less than the 6 short-finned pilot whales allowed under the Potential Biological Removal formula (Carretta *et al.* 2001).

Eastern Pacific Gray Whale - These have been an incidental catch in set net fisheries, but there have been no recent takes in groundfish fisheries (Angliss and Lodge 2002).

Minke Whale Minke whales have occasionally been caught in coastal gillnets off California (Hanan *et al.* 1993), in salmon drift gillnet in Puget Sound, Washington, and in drift gillnets off California and Oregon (Carretta *et al.* 2001). There have been no recent takes in groundfish fisheries off California , Oregon, or Washington (Carretta *et al.* 2001).

Sperm Whale - There are no recent observations of sperm whale incidental catches in West Coast groundfish fisheries.

Humpback, Blue, Fin, and Sei Whales - There are no recent observations of incidental catches of these species in West Coast groundfish fisheries.

Killer Whale - The only incidental take recorded by groundfish fishery observers was in the Bering Sea/Aleutian Islands (BSAI) groundfish trawl (Carretta *et al.* 2001). There are also reports of interactions between killer whales and longline vessels (Perez and Loughlin 1991). (Longline fishers in the Aleutian Islands reported several cases where orcas removed sablefish from longlines as the gear was retrieved.) There are no other reports of killer whale takes in West Coast groundfish fisheries (Carretta *et al.* 2001).

California Coastal Bottlenose Dolphin - Due to its exclusive use of coastal habitats, this bottlenose dolphin population is susceptible to fishery-related mortality in coastal set net fisheries. However, from 1991-94 observers saw no bottlenose dolphins taken in this fishery, and in 1994 the state of California banned coastal set gillnet fishing within 3 nm of the southern California coast. In central California, set gillnets have been restricted to waters deeper than 30 fathoms (56m) since 1991 in all areas except between Point Sal and Point Arguello. These closures greatly reduced the potential for mortality of coastal bottlenose dolphins in the California set gillnet fishery.

4.3.3.4 Impacts on Sea Turtles

The sea turtle species accounts are taken from the species accounts of the Environmental Assessment for the issuance of a marine mammal permit to the California/Oregon drift gillnet fishery (NMFS 2001a).

Table 4.3.11. Sea turtle species occur off the West Coast that are or could be of concern with respect to potential interactions with groundfish fisheries.

	Scientific Name	ESA Status
Loggerhead	*Caretta caretta*	T
Green	*Chelonia mydas*	T
Leatherback	*Dermochelys coriacea*	E
Olive (Pacific) ridley	*Lepidochelys olivacea*	T

Numerous human-induced factors have adversely affected sea turtle populations in the North Pacific and resulted in their threatened or endangered status (Eckert 1993; Wetherall *et al.* 1993). Documented incidental capture and mortality by purse seines, gillnets, trawls, longline fisheries, and other types of fishing gear adversely affect sea turtles, however the relative effect of each of these sources of impact on sea turtles is difficult to assess (NMFS and USFWS 1998a; 1998b; 1998c; 1998d). Each of the sea turtle species that might interact with groundfish fisheries are listed. Little data are available estimating total annual mortalities except in the drift gillnet fishery which is not part of the groundfish FMP. None of the alternatives is expected to result in any impacts on these species.

Loggerhead - The primary fishery threats to the loggerheads in the Pacific are pelagic longline and gillnet fisheries (NMFS and USFWS 1998c). These gears are not used for taking groundfish.

Leatherback - Primary threats to leatherbacks in the Pacific are the killing of nesting females and eggs at the nesting beaches and the incidental take in coastal and high seas fisheries (NMFS and USFWS 1998b). Groundfish fishing operations are not known to affect this species.

Olive Ridley - Occasionally these turtles are found entangled in scraps of net or other floating debris. Although they are generally thought to be surface feeders, olive ridleys have been caught in trawls at depths of 80-110 meters (NMFS and USFWS 1998d).

4.3.4 Miscellaneous Species

These miscellaneous species include various species such as sea urchins, starfish, corals, octopuses, various crustaceans and finfish. Little information on species is available about these species and the amount of interaction with groundfish fishing and fishing gears. Alternatives 4, 5 and 6 would be expected to result in reduced groundfish fishing, especially on-bottom fishing, and thus would reduce bycatch of benthic species. The establishment of long-term no-take reserves by Alternative 6 would likely provide the greatest protection to benthic animals within the reserve boundaries. Outside marine reserve boundaries, fishing could intensify. Requirements to use only certified gears may reduce the potential for increased impacts in such areas. Although there is no way to anticipate the effects of the various alternatives, no significant effects are expected. Further detailed environmental analysis would be necessary before any regulations were promulgated.

Impacts of the Alternatives on the Social and Economic Environment

4.4 Impacts on the Social and Economic Environment

To help track potential impacts, this socioeconomic analysis is organized according to various socioeconomic components of the human environment that could be affected by the alternatives. The following (Table 4.4.1) is a list of the components and examples of the specific impact assessment variables that are considered.
Precise predictions of the associated effects of the bycatch reduction alternatives are not possible due to data limitations. Therefore, this impact assessment focuses on providing a qualitative description of the economic issues, the cause and effect relationships, and the direction and general magnitude of the anticipated economic impacts of each alternative.

Table 4.4.1. Socioeconomic Components of the Human Environment and Impact Assessment Variables.

Component of the Human Environment	Impact Assessment Variables
Incentives and disincentives regarding bycatch	The benefits and costs to fishers of avoiding and/or discarding fish
Commercial harvesters	Production levels of different sectors; ex-vessel revenues and operation expenses (average costs); distributional effects among commercial harvesters such as changes in level of dependence and involvement; effects on other fisheries.
Recreational fisheries	Value of the recreational experience; benefits and costs to charter/commercial operations.
Tribal fisheries	Fulfillment of subsistence needs; revenues and costs
Buyers and processors	Gross product revenues and operation expenses (average costs)
Communities	Employment and income
Consumers of groundfish products and other members of the general public	Product prices, quality and availability; non-consumptive and non-use values
Fishing vessel safety	At-sea fatalities and injuries
Management and enforcement costs	At-sea and dockside monitoring and enforcement costs; practicability and administration costs

To identify plausible and potentially significant impacts resulting from the alternative programs, this analysis relies heavily on best professional judgement of various economic analysts and fishery management professionals. The analysis draws on records of previous experience with similar NMFS and Council management actions as represented in other NEPA environmental reviews (EISs/EAs), peer-reviewed scientific journal articles, and other previously reviewed and screened documents. This reference literature summarizes existing knowledge of impacts based on accepted scientific standards. When it is possible to draw potentially competing interpretations from the existing literature, the variations in the patterns of impacts and responses are described.

The analysis also relies on a limited number of informant interviews. These interviews were conducted with government agency personnel and other individuals familiar with the groundfish fisheries. This expert knowledge was used to supplement the available documentary record of the range of likely socioeconomic impacts of the management measures in each alternative and to determine how the effects of the alternatives considered are likely to deviate from those described in existing case studies and reports.

Social and Economic Impacts of the "No Action" Alternative

4.4.1 Social and Economic Impacts of Alternative 1 (No Action/Status Quo)

Effects on Fishers' Incentives to Reduce Bycatch

4.4.1.1 Effects on Fishers' Incentives to Reduce Bycatch

Under the current management regime, quota-induced discards can occur when fishers continue to harvest other species when the harvest guideline of a single species is reached and further landings of that species are prohibited. As trip limits become more restrictive and as more species come under trip-limit management, discards increase. In addition, discretionary discards of unmarketable species or sizes are thought to occur widely.

However, in comparison to a "race for fish" allocation system, the current management regime provides harvesters a considerable amount of flexibility to reduce unwanted catch and discards, particularly. The cumulative bi-monthly trip limits effectively guarantee each limited entry permit holder access to his or her trip limit in each two-month period, and there is little that one fisher can do to directly affect the catch of others within that period.

The use of trip limits has reduced the "race for fish" compared to a typical open access management program.

In a typical "race for fish" situation, vessels compete with each other for shares of the overall quota of fish. Because cumulative trip limits have reduced the "race for fish" in the

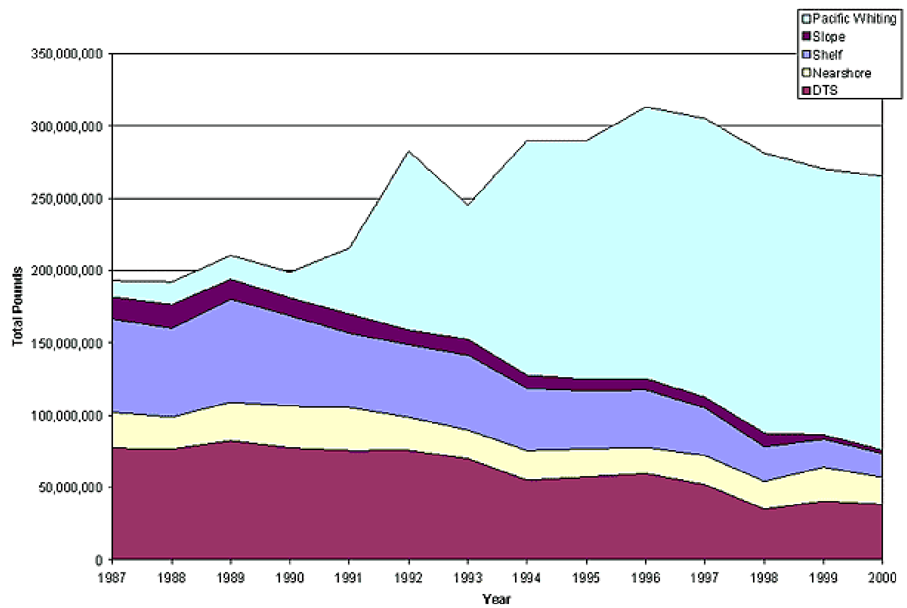
West Coast groundfish fisheries, fishers do not necessarily place themselves at a competitive disadvantage by adopting fishing practices that reduce the catch of unwanted fish (e.g., fish with low value or overfished species). For example, a vessel can take the time to move out of an area when it experiences high catches of unwanted species without the threat that other harvesters will cut into its share of the total quota. Similarly, taking shorter tows and sets to check for incidence of unwanted species does not penalize a vessel in terms of the amount of fish it may eventually catch. Finally, under the cumulative trip limit system a vessel can modify it gear and fishing strategies to reduce unwanted catches — for example, using smaller trawls or trawls with large mesh escape panels — without fearing that the possible reduced catch per effort will reduce its overall catch and revenue.

4.4.1.2 Effects on Commercial Harvesters

This section provides a brief overview of economic conditions of fish harvesters under the *status quo*. The overview describes the groundfish harvests in terms of landed pounds from major species groups and provides a brief summary of participation by limited entry and open access vessels in the groundfish fisheries through 2002.

Figure 4.2 illustrates the increase in total West Coast commercial groundfish landings from 1987 to 1996 when landings peaked at over 300 million pounds. An important feature of this graphic is the increase in landings of Pacific whiting while landings of other West Coast groundfish (primarily rockfish and deepwater flatfish species) declined by nearly 50%. This steep decline in non-whiting groundfish landings has affected a much larger segment of the commercial groundfish fleet; only a few dozen vessels actively harvest whiting, while hundreds target other groundfish species. The decline in non-whiting landings has been driven by declining

Figure 4.2. Landings in the groundfish fisheries by species group, 1987-2000. Source: Scholz 2003.



stocks of major target species, primarily several rockfish which have been declared overfished.

The decline in landings of non-whiting groundfish has had a significant adverse economic impact on a number of harvesting sectors in the past. Table 4.4.2, which focuses only on the most recent years of 1999-2002, shows exvessel revenues in the West

Table 4.4.2. Exvessel revenues in the groundfish fisheries (excluding the Pacific whiting fishery) by sector, 1999-2002.

	1999	2000	2001	2002
Sector	**Exvessel Revenues ($1,000)**			
Limited Entry Non-Trawl	9,814	10,946	8,693	6,852
Limited Entry Trawl	32,634	34,032	28,257	24,010
Open Access (All)	7,762	8,732	8,254	7,161
Total	**50,210**	**53,710**	**45,205**	**38,023**

Source: Data provided by the Pacific Coast Fisheries Information Network (PacFIN, 11/2003).

Coast groundfish fisheries increased in 2000 by 7% from 1999 levels, then dropped by 16% in 2001 and another 16% in 2002. The declines were greater in the limited entry sector than in the open access sector, with non-trawl revenues falling by a greater percentage than trawl revenues. The non-trawl sector targets higher-value species than the trawl sector (on average), and restrictions on shelf rockfish and sablefish hit that sector harder.

Earnings in the groundfish fisheries have declined substantially.

Decreased earnings in the groundfish fisheries have led to an overall decline in the number of vessels participating in the groundfish fisheries, but there are significant differences in participation trends across sectors. Figure 4.3 shows limited entry fixed-gear vessel participation from 1999 through 2002. During the 4-year period, the number of unique limited entry vessels participating in the groundfish fishery declined from 302 in 1999 to 204 in 2002 in response to various regulatory and resource changes. Reduced shelf rockfish trip limits and sablefish allocations were one cause. Declines in participation have been most noticeable during the summer months—in the July-August period the number of participating vessels declined from 242 to 142. The fact that participation in the shoulder seasons has not declined over the 4-year period suggests that the decline primarily involves “part-time” vessels, and that “full-time” vessels are continuing to participate. The establishment of a sablefish endorsement, the “tier” system, and ability of limited entry fixed gear vessels to stack permits have facilitated a reduction in fleet capacity.

Figure 4.3. Limit entry fixed-gear vessel participation by period and year, 1999-2002. Source: PacFIN data 11/2004.

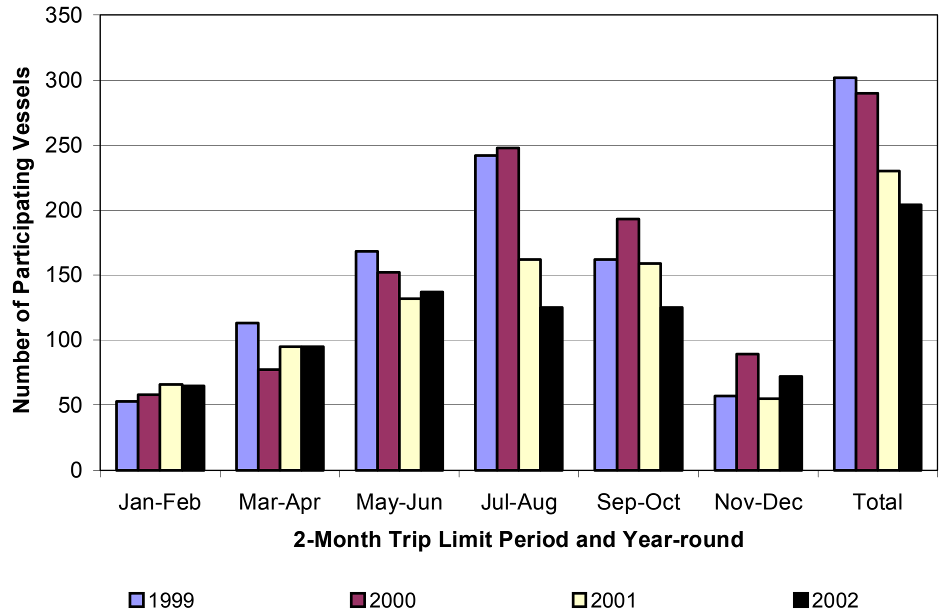
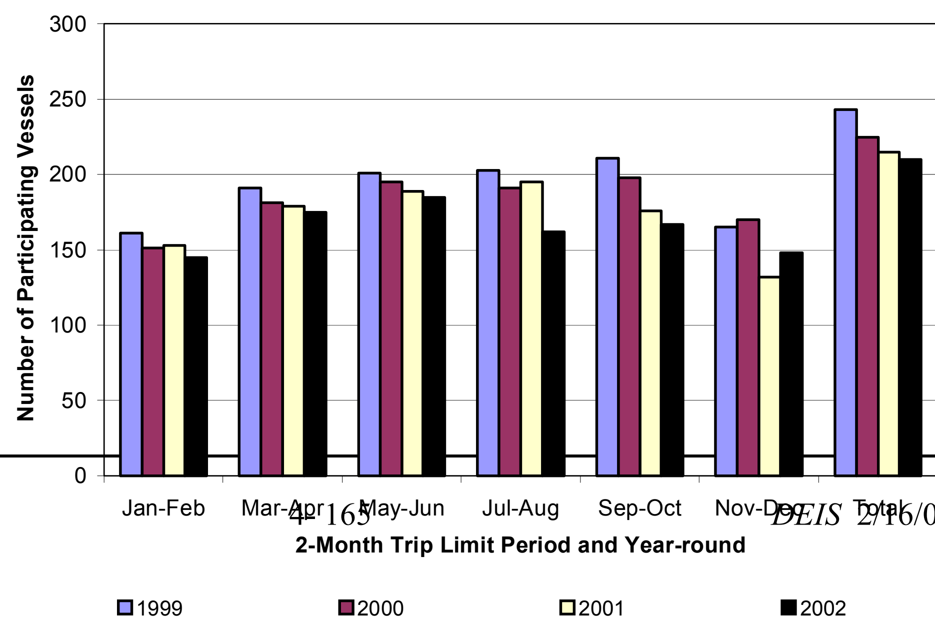


Figure 4.4 shows the participation pattern of limited entry trawl vessels, except those vessels participating exclusively in the Pacific whiting fishery. Participation by the non-whiting trawl sector is spread out more evenly over the six 2-month periods in comparison to the participation seen in the fixed gear sector. While there has been a decline in participation by the non-whiting trawl sector during the 4-year period, the decline is

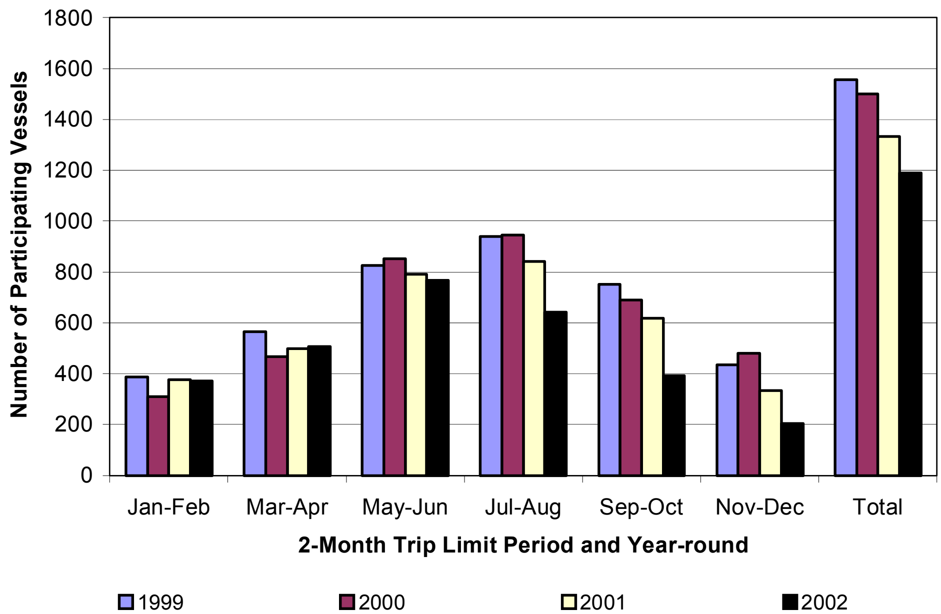
Figure 4.4. Limited entry trawl vessel participation by period and year, 1999-2002, excluding whiting-only vessels. Source: PacFIN data, 11/2004.



relatively small. However, the trawl buyback program approved in late 2003 eliminated 92 trawl permits. This means a larger decrease is expected in 2004 and future years.

Figure 4.5 shows participation in the open access sector of the West Coast groundfish fisheries. The pattern here is similar to that seen in the limited entry fixed gear sector, with higher levels of participation during the summer months, but some

Figure 4.5. Open access vessel participation by period and year, 1999-2002. Source: PacFIN data 11/2004.



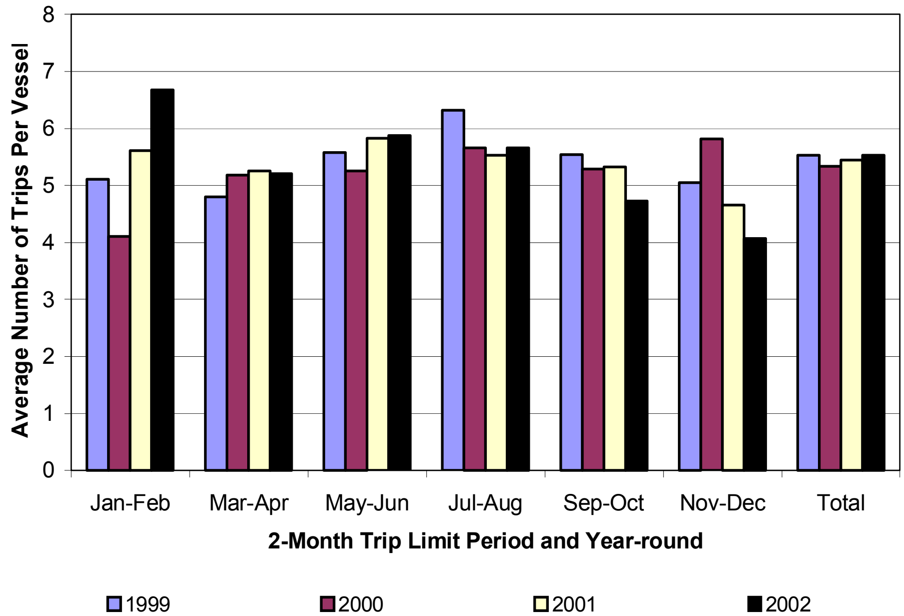
level of participation throughout the year. Overall, the decline in participation is less pronounced than the decline seen in the limited entry fixed gear sector. Nevertheless, there has been a substantial movement of vessels in the directed open access sector into other fisheries or out of fishing all together.

Despite the decline in the number of vessels participating in the groundfish fisheries, capital utilization rates continue to be low for all sectors of the commercial groundfish fishery. In 2000, analysts estimated that 9% of the limited entry fixed gear vessels could harvest all of their sablefish allocation and 12% of the vessels could harvest the non-sablefish components of the fishery (PFMC, 2000). For the limited entry trawl fishery, it was estimated that only about 27% to 41% of the existing fishing capacity was needed to catch and deliver the shoreside harvest, and 6% to 13% of the open access vessels could take that groundfish allocation.

The general downward trend in landings, exvessel revenues, and vessel participation in the groundfish fisheries is expected to persist.

Figures 4.4.6 - 4.4.8 show the average number of distinct fishing trips of vessels participating in the same three general sectors (limited entry fixed gear, limited entry trawl and open access) within each 2-month trip limit period. The number of trips within each period may be an indicator of the effects of declining trip limits on participating vessels. It is presumed that, if the number of trips that vessels take within a trip limit period is low, there is a greater likelihood that discards will occur and that higher trip limits will lead to reductions in

Figure 4.6. Average number of trips/landings per limited entry trawl vessel by period and year, 1999-2002. Source: PacFIN data 11/2003.



discards. For example, if vessels are able to take only one trip during the 2-month period, it is likely that discards due to trip limit overages will occur for many of the species. If vessels are making 3 or more trips during a period, discards due to overages may be a smaller percentage of total landings. In fact, the data show that in the limited entry sectors trips per vessels have remained relatively constant throughout the 4-year period — ranging in most cases between 5 and 6 for both sectors. While these data suggest that the amount of trip limits, particularly for target species, may not be a major factor leading to higher bycatch levels, additional analysis of trip level data of individual vessels is necessary before definitive conclusions can be reached.

A substantial number of groundfish vessel owners already derive a substantial portion of their income from other fisheries.

In terms of projecting future socioeconomic effects of continuing the *status quo*, the general downward trend in landings, exvessel revenues, and vessel participation in the groundfish fisheries is expected to persist. Some displaced fishers may switch to non-groundfish fisheries. A substantial number of groundfish vessel owners already derive a substantial portion of their income from other fisheries. Many vessel

Figure 4.7. Average number of trips/landings per limited entry fixed-gear vessel by period and year, 1999-2002. Source: PacFIN data 11/2003.

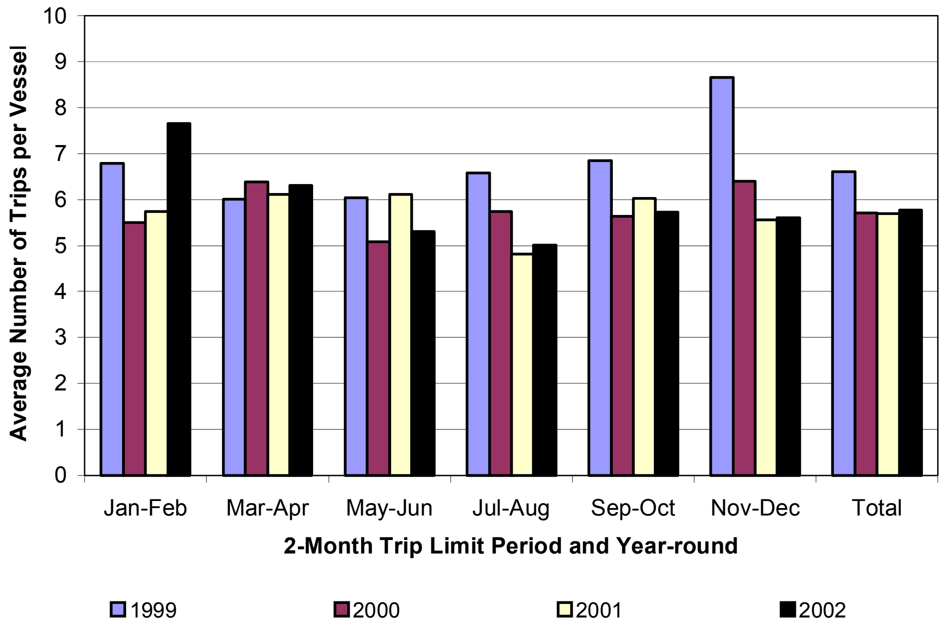
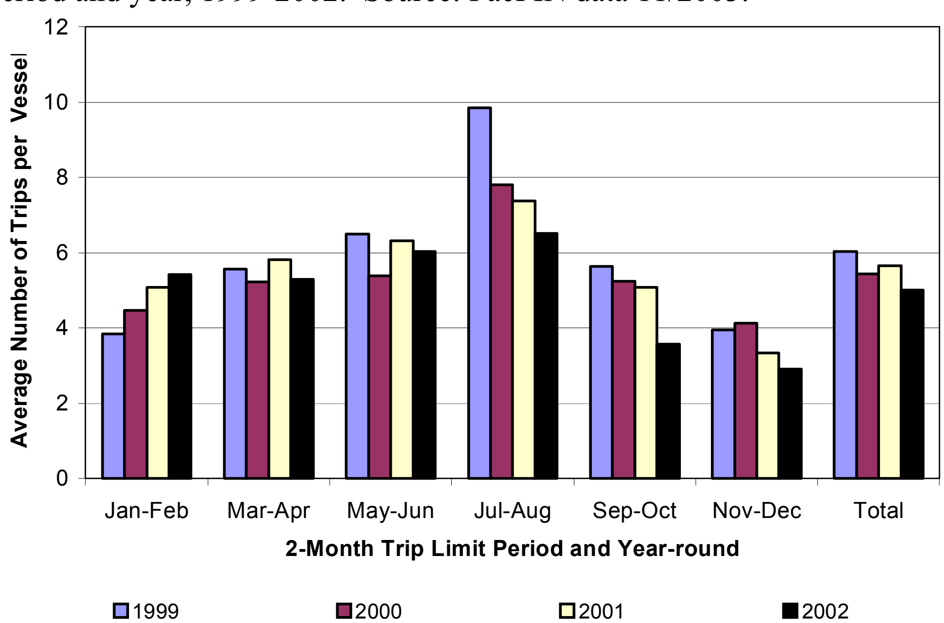


Figure 4.8. Average number of trips/landings per open access vessel by period and year, 1999-2002. Source: PacFIN data 11/2003.



owners and captains change their operations throughout the year, targeting on salmon, shrimp, crab, or albacore, in addition to various high-value groundfish species, so as to spend more time in waters close to their communities (OCZMA, 2002). These fishers are likely to recover some portion of the revenue previously generated from groundfish fishing. However, many of these alternative fisheries are already fully exploited. Furthermore, it is probable that some displaced vessel owners will have difficulty relocating their operations given the limited access programs that have been implemented in West Coast fisheries and other U.S. fisheries. In addition, some boat owners may not be capable of shifting into other fisheries without significant additional capital outlays, while others may face increased costs and uncertain markets if they are forced to shift their operations away from the communities in which they live.

Given that opportunities for displaced fishers to recover their lost harvest and income may be limited, and that the groundfish fisheries are already characterized by limited profitability, it is likely that some displaced fishers will be forced to sell out or retire. It is uncertain how active the West Coast or nationwide market is for the types of vessels, gear and other investment capital used in the groundfish fisheries. However, it is possible that the West Coast market for these assets could quickly be flooded, thereby depressing the immediate resale value of fishing equipment and vessels. Furthermore, the increasingly restrictive regulatory environment for the groundfish fisheries may diminish the long-term investment value of the vessels and permits owned by displaced fishers who opt to continue fishing. This could create an economic hardship for those fishers who are relying on money earned from selling their fishing assets to supplement their retirement funds.

Transfer of effort from groundfish to non-groundfish fisheries could also indirectly create economic hardship in the form of reduced profitability for fishers already engaged in non-groundfish fisheries. The majority of fisheries along the West Coast and other areas of the U.S. are fully utilized. If fishers in the groundfish fisheries were to shift their effort to other fisheries, catch per unit of effort and individual harvest for non-groundfish fishers would likely decline due to the intensified fishing pressure on fish stocks.

4.4.1.3 Effects on Recreational Fisheries

Recreational fishing has been part of the culture and economy of West Coast fishing communities for more than 50 years (PFMC, 2003d). Along the northern coast, recreational fishing traditionally targeted salmon, but rockfish and lingcod often provided a bonus to anglers. The estimated number of recreational marine anglers in Southern California was two and a half times the number in the next most numerous region, Washington state. While the bulk of recreational fishers in all areas were residents of those areas, a significant share were non-residents. Oregon had the greatest share of non-resident fishers at more than one-fifth of total ocean anglers (PFMC, 2003d).

Recreational fishing in the open ocean has generally been on an increasing trend since 1996; however, charter effort has decreased while private effort increased during that period (PFMC, 2003d). Part of this increase is likely the result of longer salmon seasons associated with increased abundance. Some effort shift from salmon to groundfish likely occurred around 1996, when salmon seasons were shortened in response to reduced salmon abundance. Groundfish are both targeted and caught incidentally when other species, such as salmon, are targeted. While the contribution of groundfish catches to the overall incentive to engage in a recreational fishing trip is uncertain, it seems likely that the possibility or frequency of groundfish catch on a trip adds to overall enjoyment and perceived value of the trip.

In terms of projecting future socioeconomic effects of the “no action” alternative, the general downward trend in recreational landings is expected to persist due primarily to the long-term nature of efforts to rebuild overfished rockfish stocks. This decline is expected to have a negative effect on the value of the groundfish fishing experience and may induce some anglers to either choose not to fish or to target other species. Opportunities for recreational fisheries to shift some of their effort away from groundfish resources towards other resources may be limited.

In recent years, recreational fishery catches and catch rates of some overfished groundfish (such as bocaccio) have greatly exceeded expectations, resulting in fishery closures for the first time. The validity of recreational catch estimates has been questioned, and the West Coast recreational fishery monitoring program has recently been modified to improve the precision and timeliness of recreational catch data. Data that become available over upcoming years could indicate that recent catch estimates have overestimated or underestimated recreational harvests, especially in California's large recreational fisheries. If recent recreational catches are determined to have been lower than previously believed, greater fishing opportunities would be likely in the future. If recent catches are found to be higher than previous estimates, recreational fishing opportunities could be further restricted. At this time, either scenario is plausible.

Another confounding factor is what has become known as the "rebuilding paradox." As an overfished stock increases in abundance, it becomes more likely some of those fish will be caught, unless fishing effort is reduced. Depending on the particular rebuilding strategies, this could lead to even greater restrictions in the future. Given the data limitations and speculative nature of future management actions, it is impossible to quantify impacts.

4.4.1.4 Effects on Tribal Fisheries

Four Washington coastal tribes (Makah, Quileute, Hoh, and Quinault) have treaty rights to fish for groundfish (PFMC, 2003d). The primary groundfish species targeted by Tribal fisheries are sablefish and Pacific whiting. Tribal fishers also take small amounts of black rockfish in their *USUAL AND ACCUSTOMED FISHING AREAS*. The Tribes, NMFS, and the States have negotiated formal allocations for sablefish and Pacific whiting. In addition, the Tribes' anticipated black rockfish catches are acknowledged when the Council makes its annual harvest recommendations. There are also several groundfish species taken in Tribal fisheries for which the Tribes have no formal allocation.

In most recent years, Pacific whiting accounted for the bulk of tribal groundfish harvest tonnage (PFMC, 2003d). In 1999 and 2000, 32,500 mt of whiting was set aside for treaty Indian tribes of the U.S. OY of 232,000 mt for 2000. In 2001 and 2002, the whiting OY was reduced to 190,400 mt and 129,600 mt, respectively, and the tribal allocations for those years were also reduced to 27,500 mt and 22,680 mt, respectively. To date, only the Makah tribe has fished for Pacific whiting.

In terms of exvessel revenue, sablefish landings provided well over half of total tribal groundfish revenue each year, except

1998, 1999 and 2002 (PFMC, 2003d). Approximately one-third of the tribal sablefish allocation is taken during an open competition fishery. This portion of the allocation tends to be taken during the same period as the major tribal commercial halibut fisheries in March and April. The remaining two-thirds of the tribal sablefish allocation is split among the tribes according to a mutually agreed-upon allocation scheme.

The future socioeconomic effects of continuing the *status quo* on tribal fisheries are difficult to predict. The expected continuing downward trend in the OY specifications, especially for overfished rockfish, may result in smaller tribal groundfish opportunities. On the other hand, the sliding scale methodology used to determine the treaty Indian share of Pacific whiting is the subject of ongoing litigation (PFMC, 2003d). The outcome of this litigation and its subsequent effects on tribal participation in groundfish fisheries are uncertain.

This section examines flows of non-whiting groundfish to buyers and processors and attempts to determine the impact of 2-month cumulative trip limits.

4.4.1.5 Effects on Buyers and Producers

One of the primary goals of the West Coast Groundfish FMP is to ensure a steady flow of fish to buyers and processors throughout the year. This section examines flows of non-whiting groundfish to buyers and processors and attempts to determine the impact of 2-month cumulative trip limits.

Figure 4.9. Value of Daily Landings of Groundfish (Excluding Pacific Whiting), 1999-2002. Source: PacFIN.

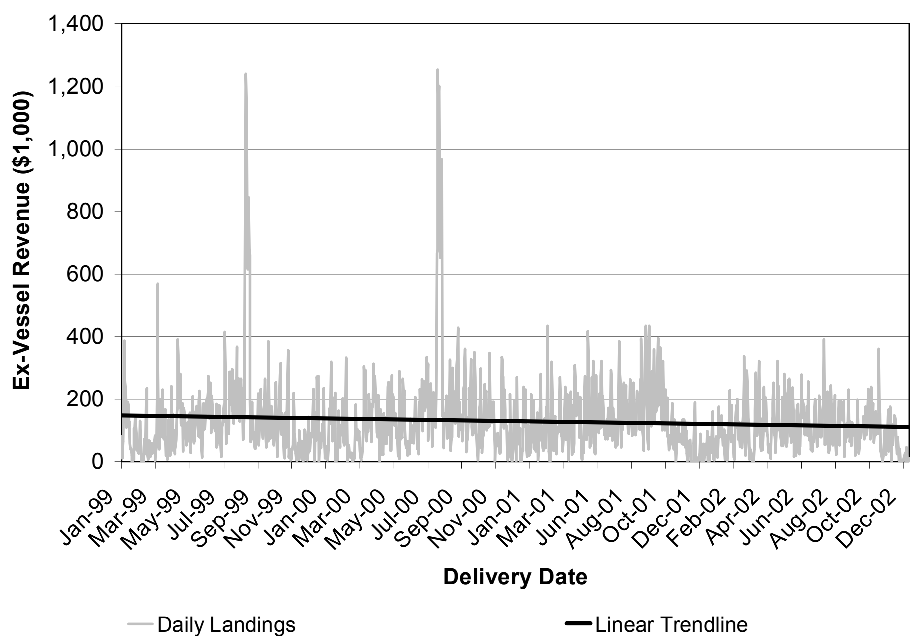


Figure 4.4.9. shows ex-vessel value of West Coast groundfish landings (excluding Pacific whiting) from 1999-2002. While the data reflect a general downward trend in revenues, they also show that there is a relatively steady overall flow of groundfish landings. In other words, the management regime appears to be relatively successful in maintaining a steady flow of product to seafood processors. It should be noted that fishery-wide data may mask variation in product flow to individual processors.

Groundfish buyers and processors have been hit hard by declines in groundfish harvest.

However, data also suggest that large buyers of groundfish have been hit hard by decreases in groundfish harvest. There was a 36% decline in buyer counts between 1995 and 2000 for those entities where groundfish was greater than 33% of their purchases and total purchases were greater than $10,000 (OCZMA, 2002). The number of buyers with total purchases greater than $1.5 million decreased by 56%.

The precipitous decline in the number of business entities is due both to reduced deliveries of groundfish and the overall consolidation within the processing industry (OCZMA, 2002). The buyer/processor sector has become quite concentrated, with approximately 5% of the buyers responsible for 80% of purchases (PFMC, 2003b). The largest buyers tend to handle trawl vessels more than smaller buyers. Of the 38 largest buyers of groundfish (those with purchases in excess of $1 million), 73% bought from trawl vessels.

Higher average costs in the processing sector are likely because of the reduction in the overall level of production.

This trend of consolidation in the processing sector is expected to continue. As the amount of target species delivered to buyers and processors continues to decline, we would expect higher average costs in this sector because of the reduction in the overall level of production. Fixed costs (i.e., costs that do not change with the level of production, such as loan repayments, general office and accounting expenses and insurance costs) will be allocated to a smaller amount of product, thereby raising the average cost per unit of product. The variable costs of processors and buyers may also increase under a continuation of the *status quo*, as the reduction in supply of fish is likely to put upward pressure on exvessel prices. These cost increases will be larger for those processors and buyers that are most dependent on groundfish. Smaller operations will probably be more affected by changes in landings than larger buyers because smaller buyers are relatively less diversified in the range of species handled. As average costs per unit of production rise, it is possible that they will exceed the value of production and lead to a temporary shutdown or permanent closing of some firms.

Processors may also face a decline in the number of skilled workers.

An additional problem that processors may face if landings decline is the maintenance of a skilled workforce (Parrish et al., 2001). Diminished work opportunities could diminish processor abilities to attract and maintain a skilled workforce. This could lead to either increased costs related to less efficient workers or additional expenditures to recruit or retain skilled workers.

4.4.1.6 Effects on Communities

The groundfish fisheries have historically provided West Coast commercial harvesters and processors with a relatively steady source of income over the year, supplementing the revenues earned from more seasonal fisheries. By maintaining year-round fishing and processing opportunities, the 2-month cumulative trip limits have promoted year round employment in coastal communities. However, the downward trend in revenues caused by lower catch limits and area closures has had a significant negative economic impact on local businesses that are directly or indirectly involved in and are supported by the groundfish fisheries. In particular, the decrease in groundfish catches has had a direct and significant negative impact on individual fishing enterprises. Fishery participants have suffered from a loss of earning potential, investment value and lifestyle. Some fishing operations have been forced to change fisheries or leave the industry. The groundfish crisis has also had a significant effect on the shoreside part of the industry (Chambers, 2002). Included are individuals or firms that process, distribute and sell fishery products and enterprises that provide goods and services to the fish-harvesting sector, such as chandlers, gear manufacturers, boatyards, tackle shops, bait shops and insurance brokers. While the percentage of business derived from the groundfish fisheries may be relatively small for some of these firms, any permanent loss of income during this extended period of stagnation in the U.S. economy could affect their economic viability.

On the other hand, when examined from a community frame of reference, the economic contribution of the harvesting and processing of groundfish fishery resources to the total economy of even small coastal communities is diluted by the relative scale of other economic activities, such as tourism and the wood products industry. Nevertheless, the finding that relatively few persons would be negatively affected economically and the overall economy of a community would not be significantly affected does not lessen the economic hardship that reduced earnings or loss of a job would create for some fishers and their families.

Those who have become unemployed face the social and psychological costs of job loss. Individuals who lose their jobs typically experience heightened feelings of anxiety, depression, emotional distress and hopelessness about the future, increases in somatic symptoms and physical illness, lowered self-esteem and self-confidence, and increased hostility and dissatisfaction with interpersonal relationships. In addition, both spouses and children of such individuals are at risk of similar negative effects. Families may find it difficult to pay bills and afford transportation, health care, and even food and clothing. The results of this financial strain may be high levels of psychological distress among some family members as well as an increase in physical health problems.

In addition to economic losses associated with declines in landings and revenues, there has been the loss of lifestyle to contend with. It is likely that enjoyment of the lifestyle or work itself is an important motivation for fishing among fishery participants. Moreover, some individuals may be motivated to fish for a living by a long-term family tradition. The loss of fishing-related jobs has caused some individuals to abandon the fishing life style. A decrease in the economic viability of the commercial fishing lifestyle has, in turn, diminished the influence of local maritime culture in some communities. The groundfish fisheries are a historically important component of an industry that is deeply intertwined with the social and cultural resources of some coastal communities. For example, the Newport Beach dory fishing fleet, founded in 1891, is a historical landmark designated by the Newport Beach Historical Society.

It is also important to recognize that fishing communities are typically dynamic and continually adapting to change (Gilden, 1999). Despite reductions in groundfish fisheries, other substantial and well managed fisheries remain available to West Coast fishers — Dungeness crab, sardines, Pacific shrimp and albacore tuna (OCZMA, 2002). Many commercial groundfish fishers have already diversified their fishing operations to include these non-groundfish fisheries. Processors, wholesalers, distributors and brokers are obtaining their groundfish from other sources or have looked for substitute products. This period of transition for the communities involved in the groundfish fisheries has been eased by Congressional appropriations for economic adjustment and recovery programs. In 2000, for example, the Federal government appropriated $5 million in social services to the states of California, Oregon and Washington to mitigate the effects of the groundfish crisis. While this level of government assistance is unlikely to continue, coastal communities are expected to continue to find ways to successfully adapt to contracting groundfish fisheries, although many more individual businesses involved in these fisheries will likely face economic hardship and possible bankruptcy.

4.4.1.7 Effects on Consumers of Groundfish Products

Alternative seafood products have shielded consumers from reduced groundfish production.

By spreading out fishing more evenly over the year, cumulative trip limits allow buyers and processors to provide a continuous flow of fish to fresh fish markets, thereby benefitting consumers and keeping consumer demand high. The decline in rockfish landings in the groundfish fisheries has probably had a minimal effect on consumers of groundfish products because of the availability of substitutes for West Coast groundfish products in the regional food distribution (PFMC, 2003d). Most supermarkets and restaurants do not rely on local supplies to stock their shelves or prepare menus (although some retail or restaurant patrons may place a premium on knowing the product they are purchasing is locally caught (Parrish et al., 2001)). Locally caught products that are no longer available are replaced with close substitutes obtained from elsewhere in the global supply chain. Although rockfish caught in West Coast fisheries are considered to be of high quality and are valued in West Coast fresh markets, similar products from South America, Mexico, Canada or Alaska can substitute for West Coast production.

4.4.1.8 Effects on Fishing Vessel Safety

Faced with greatly reduced revenues, vessel owners' may choose to delay or forego maintenance and safety equipment. Also, experienced crew tend to look elsewhere for steady employment.

Some gains in fishing vessel safety are at least partially realized under the *status quo*. Cumulative trip limits provide fishers with the opportunity to fish at a more leisurely pace and avoid fishing in dangerous weather or locations. Low earnings on the part of individual harvesters limit funds for maintenance and safety equipment. Poor maintenance, bad weather and a desperate need to fish may to lead to significant incidence of injury and losses in life and capital (Young, 2001). In addition, as revenues in the fishing industry decline, vessel owners and captains report it has become more difficult to find, hire, and keep qualified crew. While there are many skilled and capable crew members working on West Coast commercial fishing boats, many who once would have been attracted to the industry are discouraged by increasing regulations and by the apparent lack of a promising future. Conversely, the industry attracts people who are unable to find work elsewhere, and who lack the requisite skills and training. Some are itinerant, and do not stay long enough to be fully trained or invested in vessel operations—including safety (Gilden and Conway, 2000). To the extent that the groundfish crisis will deepen in the future, these negative effects on fishing vessel safety are likely to continue.

4.4.1.9 Effects on Management and Enforcement Costs

The current management regime results in a management process that is contentious, difficult and expensive. With an excessively large fleet and relatively restrictive management measures, violations are likely. Consequently, enforcement costs will be high. In addition, as fishers attempt to maintain a livelihood, they exert pressure to set harvest levels as high as possible and to allow fishing to continue as long as possible. The same pressures that induce managers to maintain high quotas create incentives for fishery scientists and concerned environmental advocates to urge for more precise stock assessments and catch monitoring. NMFS maintains a risk-averse management policy, which means that greater uncertainty regarding the status or productive capacity of a stock or stock complex corresponds to greater caution in setting target catch levels. Reducing uncertainty requires more expensive data collection and analysis systems. NMFS and PSMFC spent nearly $6 million on these activities in 1999 (the states and PFMC spent additional money). NMFS estimates that it will need nearly an additional $13 million to satisfy its highest priority needs in responding to the current groundfish crisis. If granted, research and monitoring costs would increase to about $20 million, nearly half the value of the non-whiting groundfish fishery.

Several factors influence the cost of managing the West Coast groundfish fishery. NMFS conducts scientific surveys to track abundance trends for major groundfish stocks. The trawl logbook program is administered by the States of Washington, Oregon and California, in conjunction with PSMFC. The States maintain the reporting system of commercial fishery landings and contribute to monitoring recreational groundfish catches. Commercial landings data are compiled in the Pacific Fishery Information Program, or PacFIN, and recreational statistics in the RecFIN program. The NMFS West Coast groundfish observer program contributes data on catch and discards, and state employees sample commercial landing to estimate species composition. This and other information is analyzed in comprehensive stock assessments prepared by federal, state and academic scientists. An extensive stock assessment review process provides public and scientific peer review of these assessments. Much of the Council's meeting schedule is devoted to reviewing groundfish stock assessment information, developing harvest level recommendations, developing management measures consistent with harvest levels and goals and objectives of the groundfish FMP, and monitoring the pace of groundfish fisheries over the course of the year. Typically, information is scarce, which increases the amount of discussion, debate and analysis relating to multiple management issues. The budgets of many State resource management agencies have been shrinking for several years, and federal funding for NMFS and the Council have not kept pace with the increasing complexity of the management program. Much of the complexity is the direct result of two fundamental policies: maintaining year-round fishing and marketing opportunities, and holding monitoring and other information costs as low as possible. For example, the recent trawl buyback program has eliminated roughly 90 vessels from the fleet. The NMFS "bycatch model" tracks landings by every trawl vessel and projects how each vessel is expected to respond to changes in trip limits and other measures. Participation by vessels that remain in the fishery will undoubtedly change, in part due to increases in trip limits and in part due to changing ownership as some owners of eliminated vessels reenter the fishery by purchase vessels that were not bought out. This will add an increased level of uncertainty and complexity in both the trip limit projections and bycatch projections until a level of stability is reestablished.

Technological developments are expected to mitigate the rate at which the management costs for the groundfish fisheries will escalate. For example, on January 1, 2004, a Vessel Monitoring System (VMS) was implemented for the limited entry sector of the groundfish fishery. In other regions of the U.S., VMS has proven to be an effective, cost-saving technology for the monitoring and enforcement of large restricted areas over great distances. A VMS is an automated, real-time, satellite-based tracking system operated by NMFS and the U.S. Coast Guard that obtains accurate geographic position reports from vessels at sea. The cost of VMS transmitting units has decreased as new technologies have emerged. At this time, VMS transceiver units range in price from approximately $800 to $5,295 per unit, installed (PFMC, 2003e). The more expensive units allow two-way communications between the vessel and shore such that full or compressed data messages can be transmitted and received by the vessel.

VMS does not replace or eliminate traditional enforcement measures such as aerial surveillance, at sea patrol boats, landing inspections and documentary investigation (PFMC, 2003e). Traditional enforcement measures may need to be activated in response to information received via the VMS. However, VMS positions can be efficient in identifying possible illegal fishing activity and can provide a basis for further investigation by one or more of the traditional enforcement measures. In doing so, it makes certain activities of investigating officers more cost effective because less time will be spent pursuing false trails and fishing operators who are following the rules. Furthermore, VMS positions in themselves can also be used as the basis for an enforcement action.

Another major benefit of VMS is its deterrent effect (PFMC, 2003e). It has been demonstrated that if fishing vessel operators know that they are being monitored and that a credible enforcement action will result from illegal activity, then the likelihood of that illegal activity occurring is significantly diminished. VMS transmitters are required for all limited entry groundfish vessels as of January 1, 2004.

4.4.2 Social and Economic Impacts of Alternative 2 (Larger trip limits - fleet reduction)

This alternative examines the economic effects of increased trip limits achieved by reducing the number of trawl permits by 50% from the 2002-2003 level.

This alternative was developed based on the central theme of capacity reduction in the Council's *Strategic Plan for Groundfish*. In the time since this alternative was put forward, a major capacity reduction program has been implemented, reducing the number of active limited entry trawl permits by roughly 35%. This fleet reduction was in the form of a vessel buy-back program that eliminated the purchased permits and permanently prohibits those vessels from fishing anywhere in the U.S. Congress authorized a loan that the commercial groundfish industry must repay. The goal of reducing the fleet by 50% has not been fully achieved; however, it is doubtful that another trawl fleet reduction program will be undertaken in the near future unless Congress authorizes additional funding.

This fleet reduction will have major effects on the economic and social conditions of the fishing industry throughout the West Coast, and most of those effects have not yet been observed. In many ways, this alternative is now much more similar to Alternative 1. It is not certain that cumulative trip limits will increase by the same percentage; new trip limits will be calculated based on the NMFS "*BYCATCH MODEL*" and will likely change over time as remaining vessels establish new fishing patterns. Thus, this buyback program does not fully equate to the fleet reduction measures proposed under Alternative 2.

4.4.2.1 Effects on Fishers' Incentives to Reduce Bycatch

Capacity reduction is usually pursued for reasons other than reducing bycatch, such as increasing the level of fishery profits (Pascoe, 1997). As such, effort reduction is generally not considered a bycatch management policy per se. However, reducing the level of effort in the groundfish fishery and increasing trip limits are likely to have substantial beneficial effects on the level of bycatch. In a study of West Coast groundfish, discard rates were found to vary inversely with the harvest amount of the trawl trip limits imposed (Pikitch, 1988).[1/] This finding suggests that if trip harvest limits were increased systematically with a reduction in fleet capacity, we should see a decrease in the rate of regulatory discards for overfished and target groundfish species. In addition, a reduction in the fleet size can help in developing interest in the

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1/ When the study by Pikitch (1988) was conducted, trip limits in the West Coast groundfish fisheries restricted landings for an individual fishing trip. It is likely that the study's conclusions apply to the current cumulative 2-month trip limit, although this remains an empirical question.

fishery's future and in enabling fishers to deal collaboratively and constructively with bycatch problems (Young, 2001).

Generally, capacity reduction in most forms reduces the need for other controls that may lead to regulatory bycatch in particular. Non-regulatory bycatch of groundfish may also be reduced if there are fewer boats to supply market demands. If there are delivery limits imposed on harvesters by processors, the reduced number of vessels is expected to result in an increase in those limits.[2/]

4.4.2.2 Effects on Commercial Harvesters

The Council's Science and Statistical Committee estimates that the Pacific groundfish trawl fleet would need to be reduced by 60-90% to achieve maximum economic efficiency, where the marginal costs of production are equal to the marginal revenue. The Council endorsed a fleet reduction of at least 50% as a first step towards addressing overcapacity. This reduction would eliminate some (not all) of the extra capacity in the fishery and restore the fleet to some minimum level of profitability. In economic parlance, this implies that commercial harvesters would be able to capture at least some portion of their producer surplus or economic rent (which under the *status quo* has not been feasible). In part, this increase in profitability is derived from the reduction in excess capital and labor that is embodied in an overcapitalized fleet. If excess capital is removed from the fishery and trip limits are increased, we would expect to see increases in both average and overall net revenues to harvesters. The increase in trip limits would be expected to lead to increases in retention of fish caught. Higher catch levels (assuming prices remain constant) implies increases in revenues to harvesters remaining in the fishery.

Leipzig (2001) estimated that capacity reduction and the subsequent catch increase for the remaining participants could result in a 69.5% increase in exvessel revenues for the post-buyback trawl fleet. In addition, while overall total landings may stay the same, this alternative would lead to overall reduction in the variable costs to fishers. These cost savings are in part based on the reduction in the number of times an

2/ Processors may limit the amount of each species they are willing to accept in a given delivery in order to assure an even flow of product into the processing unit.

individual vessel catches its trip limit and is obliged to invest crew time in sorting and discarding fish caught over the limit.

NMFS estimates that for every $1.00 that fishers remaining in the fishery pay in fees (a suggested tax to match Federal funds to support a buyback program), they will receive $6.80 in additional revenue from the groundfish trawl fishery (Oregon State University, 2003). A trawl industry analysis prior to the buyback referendum (Leipzig 2001) estimated a return of $22.42 for each dollar spent in fees. A hypothetical example illustrates how these estimates were derived. Suppose that a vessel in the pre-buyback fleet annually lands 200,000 lbs of groundfish, for which it earns $100,000 in exvessel revenue. The fixed costs and variable costs of the operation are $45,000 and $50,000, respectively. The net revenue of this vessels can be calculated to be $5,000. Now suppose that after the buyback the annual landings of the vessel increase to 400,000 lbs, and exvessel revenue increases to $200,000. The vessel's fixed costs remain at $45,000, and its variable costs double to $100,000. In addition, the vessel incurs a buyback repayment fee of $20,000. In this hypothetical example the vessel's net revenue grows to $45,000, nearly a 10-fold increase.

The magnitude of total economic benefits that could accrue to the Pacific coast trawl fishery from this alternative will also be affected by the distribution of vessels that retire and those that remain in service. As indicated in PFMC (2004), the number of vessels, vessel landings and ex-vessel values are unevenly distributed along the Pacific Coast. Therefore, if a predominance of vessels retires from areas of low ex-vessel value, net economic value increases to the fishery may be higher than would be the case if vessels were to retire in ports where ex-vessel values were relatively greater. This conclusion presumes that there will be a shift in landings to areas where ex-vessel values are higher. In addition, the distribution of wealth among those remaining in the fishery and among the communities in which they reside will depend on where (in terms of what port) vessels are retired and where vessels remain.

4.4.2.3 Effects on Recreational Fisheries

Currently most recreational fishing along the Pacific coast targets nearshore groundfish species such as black rockfish, lingcod and cabezon. Proposed capacity reduction under Alternative 2 will largely affect shelf and slope fisheries, thus having a limited impact on stocks of fish most frequently targeted by the recreational fleet. As such, Alternative 2 is predicted to result in minimal impact on recreational effort and/or the quality of the trips taken relative to the *status quo*.

4.4.2.4 Effects on Tribal Fisheries

The Federal government recognizes Tribal treaty rights to fish for groundfish and other marine species. The Council fulfills its legal requirement by subtracting Tribal allocations and anticipated harvests before establishing non-tribal harvest allocations, trip limits and other management measures. The trawl fleet reduction program does not apply to tribal vessels. However, tribal fisheries for species other than whiting may be favorably affected if the buyback program results in fewer non-tribal trawl vessels operating in the tribes U&A areas and fewer groundfish are taken from those areas. Any change from the status quo is predicted to be moderate at most.

4.4.2.5 Effects on Buyers and Processors

A reduction in excess fishing capacity and higher trip limits are not expected to significantly affect the total amount of fish that harvesters will deliver to processors. As a consequence, it is unlikely that we would see any price effect on producers (unless harvesters coordinate and, through collective bargaining, demand higher prices from processors). With fewer trawl vessels in the fishery, processors would have fewer boats to schedule for deliveries and offloading. The related reductions in time spent unloading vessels is expected to resulting in cost savings to the processors. On the other hand, the seafood processors in those ports that experience a reduction in fleet size may be negatively affected if they are unable to obtain supplies of fish from alternative sources. To ensure a steady supply of raw product, processors may bid up ex-vessel prices. Because processors operate in a global seafood market with many substitutes, it is unlikely they would be able to pass on their higher costs to consumers. Consequently, harvesters could capture some of the wealth that was previously retained by processors.

4.4.2.6 Effects on Communities

Depending on the geographic distribution of the remaining fleet, a fleet reduction may be a zero-sum game from the perspective of coastal communities: reduced landings and revenues in some ports may be matched by increases in landings and revenues in other ports (Schloz, 2003). The distribution of the post-buyback fleet under this alternative can not be predicted because vessels will continue to respond to economic opportunities and management measures throughout the management area. Consequently, the direction and magnitude of many of the economic effects of this alternative on particular coastal communities are uncertain.

If a reduction in fleet capacity with higher trip limits is successful in increasing net revenues or profits to fishers, positive economic impacts on the communities where those fishers land their fish, home port and reside are expected. As fishers' net revenues increase, we anticipate greater spending on basic goods and services. Increased spending on the part of fishers stimulates the local economy, generating more income, jobs and taxes within the communities. An increase in employment and income can also help avoid certain social costs. With higher trip limits, fishers may be employed more of the year so they may draw less unemployment compensation. In addition, instances of alcoholism and spousal abuse may decline putting less strain on limited social service support networks (Young, 2001). In 2000, for example, the Federal government appropriated $5 million in social services to the states of California, Oregon, and Washington to mitigate the effects of the groundfish disaster. With improvement in the economic situation of individual fishers, such costs to society could be avoided to some degree (Young, 2001).

On the other hand, some communities may experience a significant reduction in fleet size and a consequent decrease in income, jobs and taxes. These negative effects may be offset to some extent by the compensation that individuals leaving the groundfish fisheries receive from the buyback program. If these former groundfish fishers invest buyback funds in local businesses, additional economic growth may be generated in the community.[3/] However, if these individuals retire completely and leave the area, the economic impact on the community is likely to be negative.

3/ In the short-run there may be an increase in social service costs while former participants adjust to their new economic situation.

4.4.2.7 Effects on Consumers of Groundfish Products

Because the decrease in fleet capacity is partnered with an increase in trip limits, it is assumed that total groundfish landings will not change significantly in comparison to the *status quo*. Under these conditions, we would expect to see little impact on consumers of groundfish as the price per unit would not likely change. Moreover, the demand for the two groundfish species most often purchased fresh (rockfish and sole) is highly elastic because there are numerous substitutes for these products. If the prices were to increase for these species, consumers would quickly switch to some other fish or protein product.

4.4.2.8 Effects on Fishing Vessel Safety

Fewer trawl vessels sharing the available harvest means average revenues per vessel will increase. Increases in net revenue to harvesters may lead to reductions in injury and loss of life relative to the *status quo* because of the harvesters' enhanced ability to take fewer risks and use their best judgement in times of uncertain fishing conditions. In addition, higher earnings on the part of individual harvesters would increase funds for vessel maintenance and safety equipment.

4.4.2.9 Effects on Management and Enforcement Costs

A capacity reduction program results in a smaller fleet, and fewer vessels are generally easier and less expensive to monitor if the management of the fishery does not otherwise change. In addition, the fleet is expected to be more profitable — if fishing is profitable, fishers can afford investments in the future of the resource (Young, 2001). For example, they will not have the same incentives to push for maximum quotas as the current overcapitalized fleet does. A profitable fleet can also contribute to management, research and monitoring expenses that help assure the long-term stability of fishery resources. Finally, a smaller fleet may result in a certain amount of self-policing (such as is found in the current Maine lobster fishery). Self-enforcement could reduce to some extent the need for Federal and state enforcement programs, including reductions in the need for on-board observers.

However, the short term management costs borne by NMFS, the Council and States would likely not be lessened by

Alternative 2, and in fact certain costs will increase. For example, as described in the analysis for Alternative 1, fleet reduction has increased the uncertainty in the "bycatch model" at least in the near future. Further fleet reduction, as would occur under Alternative 2, would add to that uncertainty and increase management costs accordingly. As budget and personnel increases appear unlikely to keep pace, it is likely the cost will appear primarily as increased workload for agency personnel and the Council.

4.4.3 Social and Economic Impacts of Alternative 3 (Larger trip limits - shorter seasons)

This section examines the economic effects of the use of measures to reduce bycatch by reducing fishing time (shortening the season by 50%), thereby allowing for increased groundfish trip limits. In contrast to Alternative 2, Alternative 3 could be applied to all fishing sectors, including recreational and charter boats.

During the 1997 and 1998 annual management cycles, the Council considered the effects of and alternatives to the year-round fishery policy. The GMT prepared a number of reports (one is provided in Appendix E) and the issues were debated at length by the Council's advisory bodies, particularly the GAP. Several proposals would have revised the trip limit program by either shortening the entire season, establishing a series of shorter seasons, or setting different fishing periods for different vessels. After debating the pros and cons of the various alternatives, the Council decided to retain the policy and the use of trip limits to maintain fishing opportunities.

Recent data suggest that under the status quo, the average vessel makes only 3 to 5 fishing trips during a two month period (see Figures 4.4.5 - 4.4.7 in Section 4.4.1). If it is assumed that each fishing trip takes 6 days, a vessel that makes 5 trips in a 2-month period is only active for 30 days (approximately 1 month) during that period. Therefore, it appears that the current management system leaves many vessels idle during each 2-month period. Because vessels currently experience considerable down time during each 2-month period, the economic effects of Alternative 3 will differ significantly depending on the way the fishing season is shortened. To clarify these differences the analysis examines the effects of the following four possible subalternatives:

Subalternative 3a: One 6-month fishing season - Condense the fishing year from 12 months to 6 months of continuous operations. Several options under this subalternative are possible — for example, groundfish fishing could begin in January and continue through June. Alternatively, fishing could begin in January and continue through March; then re-open in October and continue through December. The harvest amounts of cumulative 2-month trip limits are assumed to double under this subalternative because the number of periods will be 50% of the number under the *status quo*.[4/]

Subalternative 3b: Two 6-month fishing seasons - Split the fishing fleet into two groups and allow the first group to fish from January to June and the second group to fish from July to December. The harvest amounts of cumulative 2-month trip limits are assumed to double under this subalternative because the number of potential participants in any given period will be 50% of the number under the *status quo*.

Subalternative 3c: Two fleets each with three 2-month fishing periods - Split the fishing fleet into two groups and allow each group to fish in alternate two month periods. The harvest amounts of cumulative 2-month trip limits are assumed to double under this subalternative because the number of potential participants in any given period will be 50% of the number under the *status quo*.

Subalternative 3d: Two fleets each with six 1-month fishing periods - Split the fishing fleets into two groups and allow one group to fish odd-numbered months and the other group to fish even numbered months. The cumulative trip limits would be the same as under the *status quo*, but each vessel would have to catch its limit in half the time.

4.4.3.1 Effects on Fishers' Incentives to Reduce Bycatch

This alternative attempts to reduce bycatch by modifying the temporal pattern of fishing effort. As indicated in the analysis of Alternative 2, discard rates have been found to vary inversely with the harvest amounts of the trawl trip limits imposed

4/ Trip limits would increase, but it is unlikely they would double because many vessel operate so far below their capacity. However, the assumption of doubling is used to simplify comparisons of the alternatives.

(Pikitch, 1988; Methot et al, 2000). Higher trip catch limits result in less regulatory discards for overfished and target groundfish species because harvesters attain their trip limits fewer times in a given year. However, depending on the way that Alternative 3 would be implemented, higher trip limits may or may not occur. If Alternative 3 were implemented in a way that reduced the number of 2-month periods in which any permit holder could fish (as in Subalternatives 3a-3c), cumulative 2-month trip limits would likely to be higher, and discards would likely be reduced. If, however, the alternative were implemented so that every vessel could continue to participate in every 2-month period (as in Subalternative 3d), higher trip limits would be unlikely and there may little reduction in bycatch. However, under all of the subalternatives it is likely that vessels would be able to increase the size of their landings per trip. Higher catches per trip would be expected to result in a lower percentage of discards relative to landed catch.

Some vessels may respond to the shortened groundfish seasons by shifting their effort to alternative fisheries rather than by increasing their effort during groundfish fishery openings. If this occurs, the level of bycatch may decrease due to a reduction in overall harvest levels.

Under Subalternative 3a, it is possible that market gluts could occur during the open months and/or existing processing capacity could be overwhelmed. These situations could drive down ex-vessel prices for certain species and/or lead to refusals by processors to take deliveries of certain species. The result could be an increase in economic discards, i.e., discards that occur even when cumulative landing limits are not attained.

4.4.3.2 Effects on Commercial Harvesters

A combination of higher trip limits and a 50% reduction in the length of the fishing season is expected to lead to an overall reduction in variable fishing costs. With larger trip limits, harvesters would be able to catch larger amounts of fish per trip. In addition, harvesters would be expected to discard a smaller percentage of total catch. The result would be a decrease in the average cost per pound caught (assuming there is no difference in the catchability of fish in various months of the year).

However, the overall impact of this alternative on the costs and revenues of commercial harvesters depends on when individual participants are allowed to fish. According to PFMC (2003d), groundfish has historically provided West Coast commercial harvesters with a relatively steady source of income over the year, supplementing revenues earned from more seasonal fisheries. Although groundfish accounted for only about 17% of total annual exvessel revenue during 2000, groundfish played a more significant role on a seasonal basis, accounting for one-fifth to one-third of monthly exvessel revenue coast wide during April and the three summer months. Flatfish harvest supplied 3-9% of monthly exvessel revenue throughout the year, and rockfish catch contributed an additional 2.5 - 6.8% to monthly exvessel revenue. Along the northern areas of the West Coast, groundfish has been particularly important just before the start of the December crab fishery. Seasonal closures could disrupt the traditional annual round of fishing activities, thereby reducing the profitability of fishing operations. [5/]

If there are seasonal differences in catchability, Subalternatives 3a-3c could have negative overall impacts on variable harvesting costs. For example, fishers may be unable to fish for certain species at optimal times (industry sources indicate that several major target species form large aggregations at certain times of the year). Subalternative 3d would be more likely to avoid these negative seasonal effects because all vessels would have some fishing time throughout the year.

Under Subalternatives 3a and 3b, in which each vessel operates for six straight months, it is more likely that vessel operators would be able to be able to find gainful employment during the off season. An individual who is available for six straight months is more likely to be hired than someone with an on-again/off-again schedule as would occur under Subalternatives 3c and 3d.

Under Subalternatives 3b-3d, the opportunity exists for skilled crew members to double their incomes, as they could get

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5/ If current restrictions on limited entry permit ownership were relaxed, a number of options might become available that would mitigate the effects of Alternative 3 on commercial harvesters. For example, if permit stacking by trawl limited entry permit holders were allowed, a single permit holder and vessel could fish throughout the year. Another option would be for two permit holders to share a single vessel. The effect of this option on fleet size could be similar to that of Alternative 2 (except no buyback fees would have to be paid). Because one of the vessels could be retired or sold, fixed costs for the new operation would equal one-half the fixed costs of the two operations working independently. If all else were equal, the two permit holders could share the cost savings.

positions on two different vessels during the year. However, the number of crew members that work on more than one vessel is likely to be equal to the number of crew members that will be unable to find positions on any groundfish vessel.

Under Subalternatives 3b-3d, it is also possible that trawl vessels would increase their participation in non-groundfish fisheries. For example, trawl vessel owners could increase their participation in the open access shrimp fishery during the periods in which they have no limited entry cumulative trip limits. Because there are groundfish bycatch issues in the trawl shrimp fishery, any reduction in bycatch in groundfish target fisheries that occurs under this alternative would be at least partially offset by increases in bycatch in the shrimp fishery.

4.4.3.3 Effects on Recreational Fisheries

The effects of shorter commercial seasons on recreational fishing opportunities is likely to be negligible because total commercial catch will not increase under this alternative. Alternative 3 is not intended to apply to the recreational fishery, but even if the scope of the alternative were expanded to include the recreational fishery, this fishery might not be significantly affected. Recent California state regulations have reduced its recreational groundfish season to as short as 6 months, and weather conditions in Oregon and Washington often limit the length of the recreational fishing season to around 6 months. Under Subalternatives 3a and 3b, the 6-month closure of commercial fishing could occur opposite a 6-month closure of recreational fishing. In this case, it is possible that the recreational fishing experience may be enhanced through higher catch rates.

4.4.3.4 Effects on Tribal Fisheries

The Federal government recognizes Tribal treaty rights to fish for groundfish and other marine species, and the Tribes, NMFS, states and the Council work to coordinate the groundfish management system. The Treaty Tribes typically manage their fisheries similarly to non-treaty fishing periods, with the exception of the Tribal sablefish and whiting fisheries. That is, Tribal regulations typically restrict Tribal hook-and-line vessels to trip limits very similar to those set for the non-tribal open access vessels. Likewise, Tribal trawl vessels are provided trip limits similar to limited entry trawl vessels trip limits. The Tribes are not required to manage in this way, and they might choose to concentrate their fisheries during periods closed to non-Tribal vessels off Washington. This could result in higher exvessel prices for Tribal fishers during those closed periods. However, given all the unknowns about the program design, any effects on Tribal fisheries from this alternative are predicted to be minimal.

4.4.3.5 Effects on Buyers and Producers

The effects of Alternative 3 on buyers and processors also depend on the way the closures are implemented. Increases in trip limits (as is possible with Subalternatives 3a-3c) and fewer vessels making deliveries during any period (as is possible under Subalternatives 3b-3d) would likely have positive economic impacts on buyers and processors. A shortened overall fishing season (as would occur under Subalternatives 3a) could have a negative effect.

Larger trip limits are not expected to substantially affect the total amount of fish that harvesters deliver to processors, although it may be possible to capture a fraction of the total catch that is currently discarded. Any change would be unlikely to cause a price effect for producers. However, with vessels taking longer and potentially fewer trips, processors would have fewer boats to schedule for landings and unloading, reducing their average costs. On the other hand, depending on the timing and length of a particular platoon's seasons, a 50% reduction in the overall fishing season may result in increased costs to processors due to the fact that they may not be able to as easily control the flow of product throughout the year. Furthermore, processors may be leaving capital idle during the closed part of the year. A closure also has the negative effect of making it more difficult to re-hire filleters and other personnel when fish are again available. Moreover, buyers and processors may have difficulty maintaining markets if product is no longer available year round. Finally, the costs of starting up an idled plant, and shutting down an active plant are significant (BBEDC, 2003).

Another negative effect that a shortened season may have on processors is the flooding of the market for certain species when the season is open. The glut could overburden processing capacity and refrigeration/freezer space and result in waste due to spoilage. However, processing plants typically establish delivery limits to reduce the potential for such problems.

4.4.3.6 Effects on Communities

Community patterns of fishery participation vary seasonally based on species availability as well as the regulatory environment and oceanographic and weather conditions (PFMC, 2003). Consequently, the impact of this alternative on coastal communities is uncertain. If higher trip limits were successful in increasing net revenues or profits to fishers, positive economic impacts on the communities where those fishers land their fish, home port, and reside would be expected. As fishers' net revenue increases, greater spending on basic goods and services would be expected. Increased spending on the part of the fishers stimulates the local economy, generating more income, jobs, and taxes within communities. In addition, there would be a general sense of increased comfort and well being on the part of community members.

As indicated in the discussion of impacts on commercial harvesters, Alternative 3 (particularly Subalternatives 3b-3d) could result in a decline in the number of active crew members if the more skilled members seek to work full-time. Displaced crew members would be at least temporarily unemployed. Similarly, if there were a 6-month seasonal closure, a large number of unemployed groundfish crew members could flood the job market. To the extent that crew members remain unemployed during the closed season, they are more likely to be a drain on community social services.

4.4.3.7 Effects on Consumers of Groundfish Products

If Alternative 3 were implemented through the use of a 6-month fishing and processing season (as under Subalternative 3a), there would likely to be a noticeable negative effect on some consumers of groundfish products. Consumers of fresh or live groundfish would be unable to obtain their fish from the same sources for half of the year. While it is likely that these consumers would be able to substitute other products for fresh groundfish, they would likely experience a decline in consumer surplus. On the other hand, if Alternative 3 were implemented by splitting the harvest sectors into two groups with one group of vessels active at any given time (Subalternatives 3b-3d), there would be few if any noticeable effects on consumers of groundfish products.

4.4.3.8 Effects on Fishing Vessel Safety

The effect of Alternative 3 on safety is uncertain because so much depends on the implementation method. Increases in net revenue to harvesters resulting from increases in trip limits would likely lead to reductions in injury and loss of life relative to the *status quo* because of harvesters' enhanced ability to take fewer risks and use their best judgment in times of uncertain weather conditions. In addition, higher earnings on the part of individual harvesters increase their available funds for maintenance and safety equipment. On the other hand, set seasons make it more difficult for harvesters to make wise decisions as to when and where to fish. Seasonal closures can potentially force harvesters to venture out in extreme weather or take other undue risks. This could lead to greater incidence of vessel accident or personal injury. This could be offset to some extent by the reduced overall time a vessel would be at sea fishing for groundfish. Reduced fishing time means less time in potentially dangerous conditions. The adverse effects on safety of human life would be greater for smaller vessels.

If the outcome of this alternative were net declines in revenues in the fishing industry (due to the inability to fish for certain species at optimal times), vessel owners and captains could find it even harder to find, hire and keep qualified crew. While there are many skilled and capable crew members working on West Coast commercial fishing boats, many who once would have been attracted to the industry have become discouraged by increasing regulations and by the apparent lack of a promising future. Conversely, the industry may attract people who are unable to find work elsewhere and who lack necessary skills and training. Some such individuals are itinerant and do not stay long enough in the industry to be full-trained or invested in vessel operations, including safety. Such individuals are at greater risk of bodily harm to themselves and may unintentionally cause accidents by generally creating unsafe conditions.

4.4.3.9 Effects on Management and Enforcement Costs

The effects of Alternative 3 on management and enforcement costs are uncertain. If Alternative 3 were implemented with a 6-month closure of all groundfish fishing and processing (as in Subalternative 3a), some management and enforcement costs would decline because there would be no fishing activity to monitor for 6 months of the year.[6/] Under Subalternatives 3b-3d there would be increased costs to assign permit holders to each group and to assure that groups that are "off" are not fishing illegally. These higher costs could be offset by the reduced number of vessels and trips that would need to be monitored at any given time.

The ability to predict vessel participation patterns would be greatly compromised by Alternative 3, regardless of which suboption was adopted. Calculation of trip limits would be more complex and contentious because vessel participation could not be accurately predicted. Also, accuracy of inseason monitoring and projections would deteriorate because historic fishing patterns would not provide useful comparisons for new fishing patterns. NMFS and the Council depend on the NMFS "bycatch model" to determine appropriate trip limits for the limited entry trawl fishery. The model requires an accurate anticipation of vessel fishing patterns for every trawl vessel. Management changes that disrupt fishing patterns erode the model's predictive power by increasing uncertainty.

4.4.4 Social and Economic Impacts of Alternative 4 (Sector catch limits- vessel caps)

This alternative would continue the use of cumulative *TRIP LIMITS* for non-overfished groundfish stocks (as under Alternative 1) but would specify *CATCH LIMITS* for *OVERFISHED* groundfish species. In addition, Alternative 4 would establish specific annual limits on the amount of overfished groundfish that could be caught by each sector. If a vessel reaches an overfished or restricted species catch (RSC) limit during a period it must stop fishing for the remainder of that period. If a vessel reaches the trip (retention) limit of a groundfish species that is not overfished, further landings of that species would be prohibited, but the vessel could continue to fish for other species. When a sector reaches an annual catch limit for an overfished species, further fishing by that sector would be prohibited for the remainder of the year. In short, each sector would be responsible and accountable for all overfished (or otherwise restricted) groundfish caught. Nine fishing sectors are identified under the current regulations: limited entry trawl;

6/ Under Subalternative 3a there is a possibility of increases in illegal fishing activity and the creation of a black market for valuable groundfish species. This could lead to increases in monitoring and enforcement costs.

limited entry longline; limited entry pot; three whiting sectors (catcher processors, motherships and shore-based); open access; tribal; and recreational. However, these sectors could be subdivided to create additional sectors. For example, some sectors may be subdivided by geographical area.

4.4.4.1 Effects on Fishers' Incentives to Reduce Bycatch

Under this alternative, every limited entry vessel could continue to discard, but unlike the *status quo*, the any overfished groundfish discarded would be recorded and counted against the vessel's catch limit for the period and the sector's annual catch limit. When a sector limit is reached, all vessels in that sector must stop fishing for groundfish for the remainder of the year (or until allowed to start again). Under this alternative one sector's harvest in excess of a limit does not affect the fishing opportunity of other sectors. However, the catch of overfished species by individual vessels within each sector can negatively affect other vessels in the sector. For example, a single "disaster tow" of an overfished species, if observed, could cause an entire sector to be shut down. In this situation, a "race for fish" could develop in which unobserved vessels eschew fishing practices that reduce bycatch in order to attain their landing limits as quickly as possible. However, observed vessels could have larger trip limits for non-overfished groundfish and would thus have incentive to carry an observer, even at its own expense.

While it is clearly in the best interest of all vessels within a sector to reduce the catch of overfished species, in the absence of individual limits there may be economic factors that reduce the incentive of individual vessels to undertake actions to be more selective in what they catch. A vessel captain who undertakes actions to reduce bycatch bears the full costs of deploying more selective gear, searching for cleaner fishing grounds, etc. While some benefits of minimizing the capture of unwanted fish (e.g., less handling time) accrue solely to the individual that incurs these costs, the benefits of avoiding closure of the fisheries to the sector are spread across all vessels. The "free-riders" that did not adopt more selective fishing methods (or even eschew bycatch reduction methods they use under the *status quo*) may develop a competitive advantage over those that do by incurring fewer operating costs and/or increasing their share of the catch limit. If the free-rider problem resulted in a noticeable redistribution of profits across the sector, no one would be motivated to continue to invest in fishing practices that reduce the catch of overfished species and other unwanted fish. However, only unobserved vessels could be free riders. By establishing individual vessel caps for overfished species, vessels have much greater incentive to avoid those species. The provision for individual vessel caps for overfished species was not initially included in this alternative but was added to increase the effectiveness (and therefore the acceptability) of this alternative. Without this provision, an observed vessel could close a sector just by continuing to fish and discard after reaching his trip limit for an overfished species. In the absence of vessel caps, vessels would be expected to move away from high bycatch areas, and peer pressure could be exerted on those who are reluctant to move. However, without formal constraints, there is always the temptation to bend the rules. If some vessels contribute to the joint bycatch reduction effort while others free-ride, the provision of the collective benefit is less than optimal (Ostrom, 1990). Individual caps for overfished species should effectively prevent the “free rider” issue, allowing cooperative patterns of behavior to emerge. For example, vessel owners and captains within a particular sector may be more willing to exchange fishing information, such as the location of bycatch “hotspots” (Gauvin et al., 1996).

The free rider problem would be less in a sectors that consists of a relatively small number of participants with common interests, such as the whiting catcher-processor fleet. In such situations, negotiation of voluntary cooperatives might be feasible. The formation of cooperatives could further facilitate collective efforts by industry to reduce bycatch. For example, contractual arrangement among cooperative members may restrict the harvest of target species in areas of high bycatch to member vessels with low bycatch rates as an incentive to promote cleaner fishing practices. Cooperative members could rely on civil law to enforce contract terms. The catcher-processor sector of the Pacific whiting fishery currently utilizes a cooperative structure to limit salmon bycatch and actively shares information on incidental catch of other species as well.

An added economic incentive for fishers to take collective action to fish more selectively under this alternative is that a portion of the groundfish OY would reserved for the sector (or sectors) with the lowest bycatch.

4.4.4.2 Effects on Commercial Harvesters

Close monitoring of sector caps for overfished species could further constrain harvest of co-occurring other groundfish, especially if sector participants ignored incentives and did not apply bycatch-reducing fishing tactics. A reduction in harvest and exvessel revenues could result from early attainment of overfished species sector caps. On the other hand, more desirable species such as yellowtail rockfish are often harvested below cumulative catch limits due to constraints associated with overfished species. This and other healthy stocks could be more accessible if sector bycatch reduction efforts were successful. In addition, the total amount of fish available for harvest is expected to increase slightly. Currently, an annual landed catch OY may be set below the ABC to account for the expected bycatch. (In 2004, only total catch OYs were set; in some previous years, landed catch OYS were set.) By improving bycatch/discard monitoring and reporting, Alternative 4 could reduce the need for bycatch adjustments because discarded fish could be counted towards OYs in-season through real-time observer reporting.[7/]

The expanded observer coverage would impose significant additional operating costs on vessel owners, especially if observers carried by vessels under this alternative are funded by a pay-as-you-go system similar that for the processing vessels in the Pacific whiting fishery. In a pay-as-you-go system, the vessel owner is responsible for making arrangement with an observer employment firm who provides the required observer services and for paying all associated costs (PFMC, 2003e). Even if the direct costs of increased observer coverage are paid by NMFS, vessels may incur substantial indirect costs. At a minimum, it is likely that observer food costs will be borne by the vessel. Limited bunk space may require vessel operators to reduce the number of crew in order to accommodate observers, resulting in a decrease in the operating efficiency of the remaining crew. Vessels may also incur costs if they choose to carry additional liability insurance. These costs would vary between individual vessels depending on the insurance carriers' minimum allowed coverage period, and the coverage approach that is taken (PFMC, 2003e).

7/ Assuming that fishery managers have been risk averse when estimating discards under the *status quo*, it is likely a system of accurate accounting of discards in the groundfish fisheries would allow fishery managers greater certainty in setting ABCs and OYs.

It is likely that the smallest groundfish vessels would be most affected by the observer requirement (PFMC, 2003e). It may be determined that some vessels are simply too small to accommodate an observer. Unless these vessels were exempt from the observer requirement, they would have to end their participation in the groundfish fisheries. Similarly, vessels with the least revenue may be excessively burdened if required to carry an observer over an extended period of time. Electronic monitoring technology, such as the installation of tamper-proof video cameras on board vessels to record activities at sea, has the potential to substantially reduce the costs of monitoring catch and discards (Appendix C). Automated monitoring equipment is currently being tested in a wide range of fishery applications. However, further testing of the effectiveness of this type of electronic monitoring technology is needed before it can be adopted as a lower cost alternative to at-sea observers.

The economic effects of this alternative on commercial harvesters may also vary by sector, depending on the mechanism for allocating catch limits. For example, managers may consider gear impacts, efficiency and other factors in determining the percentage allocation of harvest for each sector. Sectors consisting of vessels that use relatively “clean” fishing methods and generate overall gains for the fisheries (e.g., produce a higher value product, have a lower impact on juvenile stocks, result in minimal habitat disturbance) could receive a larger allocation.

Such preferential allocations may induce each sector to engage in rent-seeking behavior. Lobbying efforts to acquire the maximum allocation possible may be costly. For instance, fishers may sacrifice even more valuable fishing time to attend Council meetings, and industry associations may acquire the services of lawyers and lobbyists to help the association influence decisions on the allocation of catch limits (Anderson, 1992).

The allocation of catch limits to individual sectors could lead to cooperative patterns of behavior besides those directly related to reducing bycatch. In particular, sector members may form private agreements allocating transferable harvesting privileges as was done by catcher processors in the Pacific whiting fishery. The allocation of transferable privileges through private agreement generates benefits for commercial harvesters similar to those that might be generated under an individual transferable quota (ITQ) program (See Alternative 5 effects on commercial harvesters). Unlike ITQs, however, the distribution of fishing privileges and the system for trading, selling, or enforcing them is decided by the parties to the agreement.

Sullivan (2000) states that the ability to negotiate private agreements allocating harvesting privileges depends on certain conditions being met, including 1) a relatively small number of participants, with a sufficient community of interest to make negotiations feasible; 2) an adequate system for gathering fishery harvest data, and adequate data verification and transparency to monitor compliance and enforce it in cases of non-compliance; 3) significant barriers to prevent new participants from entering after shares have been negotiated, or else "free riders" are almost certain to be predators on the fishermen who rationalize their harvest; 4) an opportunity to attain additional value through an allocation agreement; and 5) for antitrust law reasons, when the arrangement includes one or more vertically integrated producers operating in a U.S. fishery, assurance that the relevant fishery sector's target species or incidental catch allocation(s) will be limited and fully harvested.

Once an agreement is negotiated, the parties to the agreement must have internal rule-making capability and sanctioning authority to deter those who are tempted to break the rules (Ostrom,1990). Quota shares could be created by using contracts and relying on civil law to enforce contract terms, including penalties (e.g., expulsion from the agreement) for vessels that exceed their quota holdings.

Leal (2002) states that one advantage private harvesting agreements have over an ITQ program is avoidance of the expensive rent-seeking behavior that often accompanies allocation of ITQs. Although this process may not be free from controversy, it appears to be easier for the individual participants to allocate individual shares than to have the government do it. On the other hand, Leal (2002) notes that private harvesting agreements may also have some disadvantages in comparison to ITQs. A new entrant can simply buy or lease ITQs from a quota owner willing to sell or lease. In contrast, with a private harvesting agreement, the transfer of shares to a new entrant will require becoming a party to the agreement. In addition, ITQs are likely to remain in force, especially once they acquire value through the secondary market. By contrast, the durability of private agreements depends on the willingness of parties to maintain the agreement. Even when the arrangement has no sunset provisions, or requires a majority of members to rescind it, members may not retire as many redundant vessels or invest in as much of the product enhancement capital as they would under a system of ITQs.

The cooperative patterns of behavior that may develop under this alternative are expected to generate economic benefits for commercial harvesters. These benefits may render some commercial harvesters better able to sustain the costs of an observer requirement. In addition, increased observer coverage may allow more vessels to process seafood products at sea. State fishing regulations do not allow at-sea processing of any groundfish except Pacific whiting. While there are no federal prohibitions against processing fish at sea, NMFS has proposed a rule that would require all at-sea processors to carry and pay for observers. It is uncertain whether the presence of observers will lead to a relaxation of state restrictions on at-sea processing. If it does, investments in freezing capacity could lead to significant increases in revenues for some vessel owners (OCZMA, 2002). For example, sablefish commands substantially higher prices when frozen at sea. However, even if all the possible economic benefits under Alternative 4 are realized, it is likely that paying observer costs would not be economically feasible for many vessels.

4.4.4.3 Effects on Recreational Fisheries

This alternative may have a negative economic effect on recreational fishers relative to Alternative 1. If the sector catch limit is exceeded, a closure of the recreational fishery will occur. However, under Alternative 1 this potential exists as demonstrated in frequent recreational closures and other restrictions that have occurred in recent years. Improvements in the recreational catch monitoring program may either reduce or increase the likelihood of restrictions. Under Alternative 4, NMFS' ability to detect excessive catches within the sector would be enhanced by an onboard Commercial Passenger Fishing Vessel (CPFV) observer program and expanded port/field sampling program.

A closure of the recreational fishery would result in fewer fishing experiences for private anglers and charter fishing patrons. The ability of the recreational sector to avoid a fishery closure by controlling catch of overfished species through an incentive program is likely to be limited, as there are many and diverse participants.

Dividing the recreational sector into geographical (e.g., state-based) subsectors could mitigate some of the negative effects of this alternative. For example, a resident of a state in which the recreational fishery has been closed would be allowed to fish in a state where the fishery remains open, provided he or she possesses a fishing license for that state.

4.4.4.4 Effects on Tribal Fisheries

Tribes are effectively a specified sector, with sablefish and whiting allocations that are functionally similar to species caps. The Tribes' allocations and anticipated catches of overfished species are not considered caps under the no action alternative. Alternative 4 would not change the amounts of any allocations.

If allocations were treated as caps under Alternative 4, they could have an adverse economic effect on Tribal fishers, especially if the Tribal Pacific whiting or sablefish fishery were closed as a result of early attainment of an overfished species cap. There has been some catch of canary rockfish, widow rockfish and dark-blotched rockfish in the whiting fishery. In most recent years, whiting provided the lion's share of harvest tonnage and a major portion of ex-vessel revenue. Consequently, the economic impacts of a fishery closure could be severe. However, given the experience of tribes in self-management with respect some aspects of the groundfish fisheries, their ability to avoid a fishery closure through cooperative efforts to control the catch of overfished species is expected to be relatively high.

4.4.4.5 Effects on Buyers and Processors

The economic effects on buyers and processing companies are uncertain because of the uncertainty as to whether vessel owners within sectors can successfully manage bycatch. To the extent that commercial harvesters adopt bycatch-reducing fishing tactics, higher catches in the groundfish fisheries are expected. An increase in landings is likely to eliminate upward pressure on ex-vessel prices (unless harvesters can coordinate and through collective bargaining demand a higher price from processors), and greater throughput over constant fixed costs will result in lower average costs for processing facilities.

On the other hand, if a single "disaster tow" shut down an entire fishing sector, buyers and processors may experience significant shortages of fish. Current fish processing infrastructure could be disrupted if a "race for fish" developed under this alternative (although vessel caps would tend to prevent that.) Processors could be forced to increase capacity in order to process as much fish as possible before a major fishing sector shut down. Because the total volume of fish processed may not increase substantially under this alternative, any investments in additional processing capacity would be unlikely to result in net revenue gains for processors relative to the *status quo*.

4.4.4.6 Effects on Communities

To the extent that commercial harvesters were able to prosecute groundfish fisheries without being shut down, this alternative would not be expected to have a significant economic impact on communities. The groundfish fisheries would continue to benefit fishing communities as under the *status quo*. However, if sector closures did occur, there would likely be negative impacts in fishing communities, particularly if processing plants are also forced to close.

4.4.4.7 Effects on Consumers of Groundfish Products

If this alternative did not result in early closures of major harvesting sectors, it would be expected to have little impact on consumers relative to the *status quo*, as the price per unit, product availability, and product quality would be unlikely to change substantially. However, if major fishing sectors were shut down due to unexpected catches of overfished species, consumers could see a disruption in groundfish supplies. To the extent that supplies of fresh or live groundfish from West Coast fisheries were curtailed, a loss of consumer surplus could occur. A reduction in supplies of frozen West Coast groundfish would be likely to have a minimal effect on consumer surplus because this product form has many more substitutes.

4.4.4.8 Effects on Fishing Vessel Safety

The effects on vessel safety are uncertain. Possible increases in the profitability of harvesting operations may lead to reductions in injury and loss of life because of harvester's enhanced ability to take fewer risks and use their best judgment in times of questionable weather conditions. However, if an intense "race for fish" developed, the increased competition among fishers would likely increase the risks they would be willing take to harvest fish. For example, vessels could be induced to fish in weather conditions that under the *status quo* would have kept prudent operators from fishing. The result would be a reduction in the safety of fishers while at sea.

On the other hand, early closure of a sector would reduce the amount of time those vessels were at sea, resulting in increased safety.

4.4.4.9 Effects on Management and Enforcement Costs

This alternative would be expected to notably increase management and enforcement costs for initial start up and over the long term. The sector allocations required by this alternative would take two to four years to develop, analyze and implement through the Council and NMFS management processes. However, certain other management costs would be reduced, particularly those associated with inseason catch projections.

As catch limits are allocated over an increasing number of sectors, NMFS would be required to manage increasingly small blocks of fish. It would be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches within each sector. Under Alternative 4, 60% commercial and recreational (CPFV) observer coverage, a logbook requirement for all commercial vessels and an expanded port/field sampling program to improve estimates of recreational catch would be used to monitor the harvest in each sector and ensure that catch caps are not exceeded. However, it would likely be necessary to have 100% coverage of trawl vessels to ensure the effectiveness of vessel and sector caps.

As discussed above in the analysis of the economic effects on commercial harvesters, the most costs of expanded observer coverage would be borne mostly by industry unless NMFS provided all observers at no cost to vessels. Funds for expansion of the observer program have not been identified. Nevertheless, the increase in the number of observers and its associated increase in the amount of data collected is expected to raise overall annual costs of the groundfish observer program. This budgetary increase can be attributed to additional staffing and augmented spending for data entry contracts. To monitor the catch of each vessel requires the use of increasingly sophisticated catch-monitoring tools, such as electronic reporting. Though computerized systems of electronic reporting and data management increase the quantity, quality, and timeliness of the information available for fisheries management, they also increase the demands on management staff to effectively make use of a larger and more complex data system. These additional costs to the observer program have not been estimated.

An expanded port/field sampling program to improve estimates of recreational catch would entail a larger budget for the state and federal agencies currently involved in data collection. The current program recently received additional funds so that its 2004 total budget is about $3.4 million ($2.2 million in federal dollars and $1.2 million from Oregon, Washington and California). However, it estimated that the program would require an additional $1 million to develop a comprehensive coastwide marine recreational fisheries data system (personal communication, Russell Porter, Field Programs Administrator, PSMFC, October 2003).

4.4.5 Social and Economic Impacts of Alternative 5 (Vessel catch quotas, discard caps)

This analysis examines the economic effects of the use of measures to reduce bycatch that are collectively referred to as rights-based systems, as the allocation of shares of the total allowable catch for species or species groups to individuals or groups conveys an exclusive right or privilege to catch a given quantity and species of fish (Sutinen et al., 1992).[8/] The primary focus of this analysis is the economic effects of implementing transferable restricted species quotas (RSQs) for overfished species and transferable individual fishing quotas (ITQs) for other groundfish species. However, this analysis will also briefly examine the potential economic effects of implementing group-based quota systems. The allocation of portions of the total allowable catch to fisheries cooperatives is one form of such a system (See Alternative 4 discussion of

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8/ The Magnuson-Stevens Act refers to an individual fishing quota (IFQ) as an exclusive “fishing privilege,” rather than a right. In specific reference to authorizing IFQs or other limited access systems, the Act states that such an authorization, “ (A) shall be considered a permit for the purposes of sections 307, 308 and 309; (B) may be revoked or limited at any time in accordance with this Act; (C) shall not confer any right of compensation to the holder of such individual fishing quota or other such limited access system authorization if it is revoked or limited; and (D) shall not create, or be construed to create, any right, title, or interest in or to any fish before the fish is harvested” (Sec. 303(d)(3)).

economic impacts on commercial harvesters). Another way to implement group-based quota systems is to modify an ITQ program to allow communities or other groups to enter into the market for quota shares. An example of such an approach are the measures the North Pacific Fishery Management Council approved in 2002 that would allow eligible fishing villages in the Gulf of Alaska to acquire ITQs for sablefish and halibut.

The economic and social impacts of the use of rights-based management in the West Coast groundfish fisheries will be determined largely by the initial allocation of quota shares. Persons or groups who are provided an allocation will gain an exclusive fishing privilege that others who do not receive an allocation will be denied. The effects of alternative allocations are discussed throughout this analysis and highlighted in a section describing wealth distribution issues with rights-based management (Section 4.4.5.9).

4.4.5.1 Effects on Fishers' Incentives to Reduce Bycatch

Reductions in the catch of unwanted fish under a rights-based system are expected to be achieved more easily than under the *status quo* because vessels will be more willing to accept the reductions in target species catch rates that they may incur by fishing at different times. Reduced catch rates will no longer equate with a smaller share of total catch since the vessel is assured of its right/privilege to harvest a fixed or proportional share of the total allowable catch for the entire year (as opposed to 2-month periods under the no action alternative). In addition, fishers will be better able to time their harvests to coincide with periods when the *CATCH PER UNIT OF EFFORT* (*CPUE*) of certain target species is higher and bycatch is lower. For example, Dover sole and petrale sole form large spawning aggregations in the late winter and spring (personal communication, Steve Bodnar, Coos Bay Trawlers' Association, November 2003). Concentrating fishing effort during such periods can lower levels of bycatch as well as decrease fishing costs.

Fishers under this alternative may also have more flexibility in their choice of boat/gear configurations and fishing methods over the course of a fishing season. For example, gear endorsements may be modified to allow trawl vessels to use nontrawl gear or to covert their trawl endorsement to a new category of longline, pot or generic gear endorsement. This relaxation of regulations could allow fishers to modify their fishing operations and/or gear to better use their quotas and could facilitate the adoption of more selective fishing strategies.

A potential negative effect of a rights-based system is that fishers may have a heightened incentive to high grade: by throwing less valuable fish overboard, they can save their quota for more valuable fish. Under Alternative 5, however, vessels are "charged" for their entire catch and high grading does not save any of their quota . Unlike Alternative 1, the amount of fish discarded by each vessel would be recorded by an at-sea observer and counted against the vessel's limit. When a vessel reaches any catch limit, further fishing by that vessel for any groundfish would be prohibited until it acquired additional RSQ or ITQ shares. This measure provides strong economic incentives to reduce the catch of unwanted fish because it "internalizes" the external costs of discarding that fish in the private economic returns of individual fishers (i.e., the costs of discarding are borne directly by the fishers that discard). Consequently, it would be worthwhile for each fisher to take steps to improve the selectivity of their fishing gear and techniques and avoid "troublesome" areas in the process. As a further economic incentive to fish more selectively, this alternative reserves a portion of some or all of the total allowable catch limits of overfished species for vessels with the best bycatch performance. Performance could be based on low incidental catch and/or bycatch rates or other factors.

4.4.5.2 Effects on Commercial Harvesters

Initial distribution of quota shares is a major policy issue that determines distribution of wealth and costs throughout the industry. Although there are many possible methods of determining initial allocation of shares, catch history is likely to be a major consideration.

Current vessel owners as a group are likely to benefit from a rights-based system that allocates freely transferable and leaseable quota shares to vessel owners on the basis of vessel catch histories. The overall increases in profitability for vessel owners will vary from fishery to fishery but could be substantial in many cases.

Not all vessel owners would benefit equally, and the relative benefits would depend on the formula that relates catch history to allocations. This formula is clearly of fundamental importance to individual operators in the industry, as it would affect both their wealth, through changes in the value of their fishing rights, and their income as affected by their catch (Geen et al., 1993). The fact that there is a history of trip limits under the *status quo* may facilitate the allocation of ITQs in the West Coast groundfish fisheries. The value of a limited entry permit currently reflects the potential earnings of a pre-determined catch amount. However, although no permit holder has the potential to land any more fish than any other permit holder given standard trip limits that apply, there is catch history variation due to vessel decisions, trip limits that vary by region, and trip limits that vary by gear (e.g. small foot rope -large foot rope). There can be a significant variation in the catch history within the fleet. In this situation, a relatively simple allocation formula, such as one that issues equal shares to all active permit holders is unlikely to be considered fair and equitable.

Another policy issue is who would be eligible to receive shares in the initial distribution. If a substantial portion of the initial quota shares is allocated to other groups (e.g., crew, processors or community groups), vessel owners could potentially suffer an initial financial loss since they would have to purchase quota to conduct their historical level of fishing. Whether or not other gains in cost reduction or increased prices might offset the costs of acquiring quota can only be determined after the structure of the rights-based system and allocation formula are determined, and even then it would be difficult to assess.

It is also important to note that the level and distribution of the benefits and costs of a rights-based system may vary by fishery and sector. The extent of the gains would depend on the degree to which the current management and bycatch mitigation programs have been leading harvesters and processors to sacrifice quality, produce lower value products, use more costly production processes, endure higher bycatch rates, or maintain excess capital and labor in order to increase production. Experience with rights-based systems in other fisheries suggests that improvements in the economic performance of the groundfish fisheries due to increased value and reduced costs may be substantial. However, because landing limits have been used in the West Coast groundfish fisheries to smooth out fishing and landings over the year, these fisheries already experience some of the typical gains from rights-based systems that result from elimination of the “race for fish” phenomenon, such as longer fishing seasons, mitigation of market gluts, and opportunities to improve product quality.

Nevertheless, a rights-based system would be expected to increase the value of production in the West Coast groundfish fisheries for a variety of reasons. Currently, an annual landed catch OY may be set below the ABC to account for the expected bycatch. Under Alternative 5, this reduction would not be necessary because all catch mortality would be measured through expanded observer coverage. Consequently, the total amount of fish available for harvest would increase.[9/] Further, increases in the value of production may be achieved as the harvest volume increases in fisheries that were previously constrained by landing limits. For example, some fishers may successfully modify gear and/or purchase enough canary rockfish restricted species quota (RSQ) to take advantage of yellowtail rockfish ITQ.

The costs of harvesting are also expected to fall for a variety of reasons. The ability of harvesters to catch their entire quota of certain species during periods of time when the species aggregate could substantially reduce fishing costs. In addition, individual vessels will have the opportunity to select the least-cost combination of fishing inputs (Crutchfield 1979; Scott 2000). At the industry level, costs will fall because production is expected to shift over time toward the most cost-effective harvesting operations. Consolidating harvesting operations and retiring or selling off vessels will reduce fixed costs for the industry. The cost savings will depend both on the constraints put on the transfer and consolidation of harvesting privileges and on the level of excess capacity prior to implementation of a rights-based system. It is also important to note that many of the efficiency gains from the adjustment of the fleet following the introduction of a rights-based system may be lost if departing fishers shift their effort toward non-groundfish fisheries which themselves are overcapitalized. One additional potential benefit to vessel owners from a rights-based system is that private banks and government agencies may come to treat quota shares as having financial value that may allow them to serve as collateral for loans, thereby improving the ability of quota holders to obtain financing for capital investments.

These economic benefits must be weighed against the additional operating costs that vessel owners will incur from the expanded

9/ Assuming that fishery managers have been risk averse when estimating discards under the *status quo*, it is likely a system of accurate accounting of discards in the groundfish fisheries would allow fishery managers greater certainty in setting ABCs and OYs.

observer coverage required under a rights-based system (See Alternative 4 discussion of effects of increased observer coverage on commercial harvesters). The increase in net revenues that commercial harvesters are expected to experience under a rights-based system may render them better able to sustain the costs of an observer requirement. However, even if the economic benefits of a rights-based system are fully realized, it is likely that paying observer costs would not be economically feasible for many vessels because they would not be able to generate enough cash flow to cover those additional costs. As noted in the effects analysis for Alternative 4, the installation of video cameras on board vessels to document activities at sea has the potential to substantially reduce the costs of monitoring catch and discards (Appendix C). However, further testing of the effectiveness of this type of electronic monitoring technology is needed before it can be adopted as a lower cost alternative to at-sea observers.

Implementing a rights-based system presents special difficulties for fisheries such as the West Coast groundfish fisheries in which multiple species are often caught together. Matching quota to actual harvests is problematic because of uncontrollable factors such as ocean temperature and other environmental factors that can lead to variations in the mix of species caught from place to place and over different periods. Moreover, "disaster tows" can occur in which the dominant species is other than the target species. In theory, a rights-based system can address the problem through quota trading, either by purchase or lease of additional quota (Dewees and Ueber, 1990). In some cases, however, the fisher may be unable to buy or lease more quota. This might be because no other harvester has quota to sell or the trading price for quota is greater than the fisher is able to pay. (The prices of RSQ shares may become especially high as the fishing season progresses due to the constraints they may impose on harvests of target species.)

Pascoe (1997) describes a number of contingency systems that have been used to address these problems in multi-species fisheries with varying success. A permissible quota over-run is used as a bycatch management option in New Zealand and British Columbia (Larkin et al., 2003; Wheeler et al. 1992 cited in Pascoe, 1997). A permissible quota over-run policy allows fishermen to exceed their quota holding in a given year in return for a reduction in their quota the following year. In New Zealand, permissible quota over-runs are limited to 10% of the original quota for all species. Another system used in New

Zealand allows fishers to land species for which they do not hold quota and record it against the quota held by another fisher. This is effectively an informal quota leasing arrangement, as the catchers of the fish usually pay the holders of the quota for the use of their quota (Baulch and Pascoe, 1992 cited in Pascoe, 1997).

The need for such contingency systems can also indicate an inadequacy in the formal quota trading system. For example, if all quota purchases or leases are required to be recorded by NMFS, the transaction costs might be high due to bureaucratic inefficiencies. An alternative would be to allocate quota to a cooperative and allow its members to internally distribute the quota shares and develop a system for leasing and selling shares. When the quota trading system is decided by fishers themselves, transaction costs can be substantially lower.

In general, cooperatives can be expected to provide the same net benefits to vessel owners as an ITQ program. However, the rules governing cooperatives will be important in determining the distribution of benefits between harvesters and processors. For example, it has been argued by some fishing vessel owners in the Alaska pollock fishery that the rules for inshore cooperatives established under the American Fisheries Act have actually hurt independent vessel owners financially. Rules for these cooperatives restrict the ability of vessels to transfer between cooperatives and require members of a cooperative as a group to deliver 90% of their catch to one processing firm associated with that cooperative. Compared with cooperative rules that would allow for free movement of vessels between cooperatives, the present inshore cooperatives shift the balance of power in price negotiations toward the processors. Halvorsen et al. (2000) reported that variations on the current rules that would allow smaller groups of fishing vessels to form cooperatives and easier movement between plants would tend to shift the balance of bargaining power to vessel owners. This shift, in turn, would increase their share of any net benefits resulting from increased efficiency and product value that might occur as a result of rights-based management. In short, the overall gains to vessel owners that might be expected in terms of increasing the value of catch and decreasing harvesting costs are likely to be smaller with cooperatives than with ITQs if the ability of vessel owners to form and transfer between cooperatives and to freely choose their point of delivery is limited.

The impacts of community quota programs on vessel owners is even less clear. Some vessel owners might gain if communities, in turn, grant them catch rights that enable them to slow down and choose fishing times; however, there is the potential that others might be harmed financially if their current ability to harvest resources is curtailed and they need to buy or lease catch rights from communities. Even if a community grants catch rights at no charge, the profitability of the vessel owners could still be undermined if their freedom to choose which buyers they sell their fish to is limited by the community.

4.4.5.3 Effects on Recreational Fisheries

An IFQ program would not apply to the recreational fishery, and an IFQ would not necessarily result in any change in the proportion of the total groundfish catch taken by or allocated to the recreational sector. However, in order to protect the IQ shares for the commercial fleet, Alternative 5 would require establishment of hard caps (catch limits) for the recreational fishery similar to or the same as those in Alternative 4. In this respect, Alternative 5 may have a negative economic effect on recreational fishers relative to the *status quo*. A closure of the recreational fishery due to reaching its allocation would result in fewer fishing experiences for private anglers and charter fishing patrons. Dividing the recreational sector into geographic (e.g., state-based) subsectors could mitigate some of the negative effects.

If the ITQ program were expanded to include the recreational sector, or if recreational fishers, fishing groups or charter companies were allowed to obtain quota shares, the economic effects of Alternative 5 relative to the *status quo* would be different. The following analysis of potential economic effects on the recreational and charter fishing sectors draws from Anderson's (1992) discussion of the possibility of creating ITQs for both recreational and commercial fishers.

Anderson notes that an advantage of fishery management with ITQs is that it is possible to simultaneously create tradable quota shares for various sectors, including the recreational, charter and commercial fishing sectors. There are many options that could be developed. With full trading of ITQ shares permitted between sectors, users could determine the most desirable allocation of the stocks based on their willingness to pay for shares of the resource. For example, recreational harvesters could increase their share of tota1 catch by purchasing ITQ shares from commercial harvesters or commercial harvesters could buy recreational ITQ shares.

An obstacle to establishing the initial allocation of quota shares for the recreational sector is that individual recreational landings are typically difficult to document. Anderson suggests that recreational ITQ shares could be given away on an equal basis through a lottery. Entities such as fishing clubs or state/local government agencies could also receive shares if it is decided these groups were proper representatives of recreational fishers. Part of the initial recreation allocation could also be assigned to non-ITQ bag limit fishing.

4.4.5.4 Effects on Tribal Fisheries

Alternative 5 would not change any Tribal allocations. If Tribal fishers are included in the IQ program, or allowed to purchase IQ from non-tribal fishers, they would receive similar benefits. Alternative 5 is expected to have a minimal economic effect on tribal groups. The coastal Treaty Tribes have negotiated allocations of sablefish and Pacific whiting, and there are several other groundfish species taken in Tribal fisheries for which formal allocations have not been established. Allocations of these species could be negotiated in a similar manner.

4.4.5.5 Effects on Buyers and Processors

Groundfish buyers and processors are expected to benefit from the anticipated increases in fish landings that result from the implementation of a rights-based system as discussed in the effects on commercial harvesters. The overall level of benefits and the distribution of benefits across processors may depend largely on the formula for allocating quota shares. Owners of processing plants (other than catcher processors) have not been granted allocations of shares in prior ITQ programs in the United States, although such allocations may be granted under the Alaska crab fisheries rationalization program. Arguments have been made (e.g., Matulich and Server, 1999; Matulich and Clark, 2003) that harvester-only ITQ programs may lead to expropriation of quasi-rents from processors.[10/] This could result if excess processing capacity exists and there are no

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10/ Quasi-rent is the difference between the selling price and the variable costs of a product. “Expropriation” here means some potential benefits would go to harvesters instead of processors.

alternative uses for processing equipment. It is also possible that plant owners would share in the overall economic gains that could be made through fishery rationalization. The degree to which this might occur will likely depend on the level of excess capacity and the degree to which plant owners are engaged in competition with each other to gain market share. If processors are somehow guaranteed shares, they would naturally be more likely to benefit or less likely to suffer harm from implementation of a harvester-only ITQ program.

The discussion of the effects of Alternative 1 on buyers and processors indicates that processors have been able to maintain a steady flow of fish into their plants and, therefore, have been able resist the competitive pressure to outbid competitors for raw materials even in the face of declining harvests. Furthermore, even though each harvester is effectively guaranteed his or her trip limit in each two-month period under the *status quo*, fishers as a group have not been able to acquire a significant amount of bargaining power in exvessel markets. These factors suggest that the conditions in which harvesters can usurp processor quasi-rents, as described by Matulich and Server (1999), may not be present in the West Coast groundfish fisheries. While the absence of such conditions should not necessarily preclude the allocation of shares to processors, it is important to recognize that a significant loss of processor bargaining power does not appear to be likely under a harvester-only ITQ program.

As noted above, the structure of cooperatives in which harvesting agreements are negotiated can also affect the benefits that accrue to owners of processors from rights-based management. In general, processors can be expected to benefit more from a cooperative structure in which the ability of vessel owners to form and transfer between cooperatives, to sell or lease catch rights, and to freely choose their point of delivery is limited, though the absolute distribution of profits created by the move to cooperatives in any particular fishery is not clear.

Community fishery quotas might also provide protection to processors in small communities if the communities restrict the landing locations of their quotas. However, if the program worked similarly to the current western Alaska CDQ program, communities could lease out quota to operations that processed elsewhere and local processors might be preempted.

In summary, rights-based systems may have the potential to reduce the competitiveness of markets and shift the balance of bargaining power between harvesters and processors. Care must be taken to minimize threats to competitive markets and to avoid, or at least be aware of, shifts in bargaining power that may result in income transfers between processors and harvesters. Exvessel markets for fish may already be quite thin in the West Coast groundfish fisheries, with few buyers in a number of locations. Consolidation of harvest and processing sectors will make these markets thinner yet. The number of buyers competing for fish may be reduced to a few or a sole buyer in some cases if restrictions were to be placed on where fish can be delivered. The possible result would be a shift in income from harvesters to processors.

On the other hand, without restrictions on where or to what plants fish can be delivered, income transfers may move in the other direction. The temporal spreading of fishing may cause processors to bid up prices in an attempt to lower average costs by increasing the amount and duration of their processing. As Matulich and Server (1999) point out, there is the potential under certain conditions that the quasi-rents of processors may be expropriated by harvesters in this process. The possibility also exists that harvesters with sufficient shares of the total allowable catch might have enough market power to make monopoly profits by reducing output below the catch limit. However, the danger of monopolistic practices is low, as West Coast groundfish are sold in regional, national and international markets where they must compete with similar species produced in other regions of the world as well as with other seafood products.

4.4.5.6 Effects on Communities

Prior rights-based systems implemented in U.S. fisheries have not allocated initial quota shares to vessel crews or other employees of fishing or processing companies. If any of these individuals were allocated shares under a rights-based system, they would be expected to make financial gains similar to those made by vessel owners receiving shares.

If crew members are not allocated shares, it is uncertain whether they could expect their long-term earnings to rise or fall with a rights-based system. In the Alaska halibut and sablefish ITQ fisheries, crew members have sometimes been expected to contribute toward the cost of quota shares used, but increases in the value of production have led to higher crew incomes. Whether crew members and other seafood industry employees are likely to share in the net gains in profitability that result from an ITQ program or other rights-based system implemented in the West Coast groundfish fisheries will depend on the supply and demand for labor, which is likely to vary by fishery and area.

One likely impact in any type of rights-based system is a decrease in the number of crew members and processing workers employed. This is a natural consequence of the consolidation of fishing and processing activities to fewer vessels and plants. As a form of compensation for the potential loss of employment opportunities in the Alaska sablefish and halibut fisheries, the North Pacific Fishery Management Council made the provision that the only persons who could purchase IFQ shares that were not initial recipients had to be "bona fide" crew members with at least 150 days of fishing experience. With this provision, crew members who might otherwise lose their jobs can establish themselves in the fishery, and because the owner of the quota shares is required to be onboard when the IFQs are fished, these crew members can guarantee themselves a position (Hartley and Fina 2001b). Moreover, crew members who purchase quota shares increase their value as crew, as their quota shares add to the overall harvest limit of the vessel on which they work (Ginter and Muse, 2002).[11/]

On the other hand, rights-based systems could lead to the preemption or reduction of fishing, processing, and shoreside support activities in some traditional fishing communities unless restrictions are implemented to inhibit or prohibit a geographic

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11/ Both crew members and vessel owners have been assisted in purchasing sablefish and halibut IFQ shares by the North Pacific IFQ loan program, a financing mechanism authorized by the MSA in 1996. The Magnuson-Stevens Act specifies that 25% of the fees collected by NMFS to manage the sablefish and halibut IFQ program must be deposited in a U.S. Treasury Department account and made available for appropriation to support the loan program. To date, however, the program has largely been supported by a Congressional appropriation. The Magnuson-Stevens Act specifies that the loan program is to provide aid in financing the 1) purchase of individual fishing quotas in that fishery by fishers who fish from small vessels; and 2) first-time purchase of individual fishing quotas in that fishery by entry level fishers. Currently, the program has approximately $5 million available for financing quota share purchases. In FY 2002, 39 loans were issued, mostly to vessel owners and crew members who fish from small (< 60 ft. LOA) vessels.

redistribution of landings. This would be a natural consequence of consolidation in the industry as excess capital is scrapped or allowed to degenerate without replacement and production is shifted to more efficient operations. Even if reductions in harvesting and processing capacity were uniform across communities, one would expect a decrease in economic activities in fishery support sectors due to reductions in harvesting and processing capital. ITQ programs and cooperative programs can be designed to reduce or prevent this. Doing so could entail some sacrifice in overall efficiency gains, but this must be weighed against the social benefits of preserving traditional fishing communities.

Granting quota shares to community groups would be an alternative and more transparent way to assist traditional fishing communities in remaining involved in the fisheries or in providing them financial resources to develop new industries. Moreover, such group-based systems may lead to a more optimal concentration and reallocation of quota shares in the sense that broader social considerations could be internalized (Gréboval and Munro, 1999).

In conclusion, constraints on the restrictions on the use, transfer and accumulation of ITQs may serve to protect communities' or fishery sectors' opportunities and benefits. However, the social benefits of these measures should be weighed against the efficiency losses. The greatest increase in profits for the overall industry is likely to come from a system with a minimum of constraints on transferability and use of quota shares. For the industry as a whole, increases in profitability can be achieved by shifting harvesting and processing from less efficient operations to more efficient ones. Gains in economic efficiency may be made by concentrating production in fewer operations, especially if there are firms with excess harvesting or processing capacity—as continues to be the case in most sectors of the West Coast groundfish fisheries. Furthermore, it is possible, but by no means certain, that there are economies of scale that would favor larger firms and lead to greater concentration of the industry. At the same time, however, one must recognize that it is this potential for increasing profits by shifting and concentrating harvest and processing operations that poses the threat of preemption of sectors and communities.

4.4.5.7 Effects on Consumers of Groundfish Products

Because landing limits in the groundfish fisheries already maintain a year-round season, consumers are already experiencing some of the typical gains from rights-based systems, such as the availability of fresh fish in markets throughout the year. In addition, consumers are expected to benefit from the anticipated increases in fish landings that result from the implementation of a rights-based system.

There is some chance that consumers could be negatively affected, if a rights-based system leads to a decrease in the overall competitiveness of markets for certain groundfish products (e.g., live fish). The likelihood of this occurring depends both on the level of consolidation that might occur and the elasticity of demand for particular products. A decrease in competitiveness could result in higher product prices without accompanying increases in quality, which, in turn, would reduce consumer surplus.

4.4.5.8 Effects on Fishing Vessel Safety

Alternative 5 would be predicted to improve the safety of groundfish fishing operations compared to the *status quo*. As with a number of effects previously discussed, the gains in fishing vessel safety that are typically attributed to rights-based systems are partially realized under the *status quo*. These fishing safety benefits include the opportunity to fish at a more leisurely pace and avoid fishing in dangerous weather or locations, within the constraints of 2-month fishing periods. However, under Alternative 5 the constraints of 2-month periods would be eliminated, allowing vessels to operate in the best possible conditions. The result would be further reductions in injury and loss of life because of harvester's enhanced ability to take fewer risks and use their best judgment in times of uncertain weather conditions. In addition, if higher net earnings are realized under a rights-based system, individual harvesters will have additional funds for vessel maintenance and safety equipment. At the same time, it is important to recognize that rights-based management does not guarantee that fishers will adopt safe fishing practices. Under an ITQ program, for example, market opportunities may still encourage fishers to fish at times or in places that are unsafe. For example, some fishers may still choose to fish in bad weather if the best price for catch is offered during and immediately after storm periods.

4.4.5.9 Distribution Issues with Rights-Based Management

As noted previously, the economic and social impacts of expanded use of rights-based management in the West Coast groundfish fisheries would be determined largely by the initial allocation of quota shares. Whether shares of the total allowable catch are allocated to individuals, cooperatives or communities, the basis for determining the allocation would undoubtedly be controversial. The allocation mechanisms are likely to vary significantly, depending on the type of rights-based system or systems implemented. If the Council and NMFS decide to move towards a rights-based management program, consideration of specific alternatives and further analysis of impacts will be required.

During the development of a rights-based system, a wide variety of allocation mechanisms and formulas should be considered. Although past ITQ programs in the United States have allocated quota shares to vessel owners based on catch histories, other options should also be examined, such as those that attempt to incorporate objectives that maximize net benefits to society. For example, the criteria for initial allocation of quota shares could include a vessel's acceptance of conservation goals (National Research Council, 1999). Further, retention of shares could be contingent on the vessel's ability to pass a regular performance review.

When allocating quota shares, it is important to bear in mind that granting shares to individuals free of charge is likely to result in those individuals receiving substantial windfall gains. These windfall gains may be construed as a transfer of wealth from the public to certain individuals, since exclusive withdrawal rights to publicly owned resources are being gifted. Whether and to whom this wealth should be gifted is an important question that should be carefully considered.

It has been argued that vessel owners have invested their labor and risked their capital (and often their lives) to develop fisheries, and, in return, they should be given preferential access to those resources. However, vessel owners as a group are only one element of a diverse collection of stakeholders who might be viewed as possessing a "right" to benefit from resources harvested in federally-managed fisheries (or from other resources directly or indirectly affected by those fisheries). Possible other stakeholders include, but are not limited to, skippers who are not vessel owners, vessel crew, processors, fisheries scientists, persons with interests in marine conservation, and individuals in communities that support fishing and processing operations,. Clearly, there are equity reasons for considering whether and how these other stakeholders might be included in initial allocations of ITQ shares. Furthermore, the Magnuson-Stevens Act requires fishery managers to consider the allocation of a portion of the annual harvest in a fishery for entry level fishers, small vessel owners, and crew members who do not hold or qualify for individual fishing quotas.

While recognizing that the Magnuson-Stevens Act may currently restrict such actions,[12/] fishery managers might also consider the future prospect of selling or auctioning some or all of the ITQ shares to allow the public to capture all or a share of the windfall gains created by the ITQ system (Macinko and Bromley, 2002). A variety of tax mechanisms could also be used to capture a portion of the net economic returns that fish harvesting might generate and place them in the public coffer. The mechanism for collecting these profits should be implemented at the beginning of the ITQ program, as the windfall gains accrue to the initial holders of quota (Sutinen et al., 1992)

If cooperatives are expanded to other West Coast groundfish fisheries, the cooperatives themselves would likely be responsible for allocating quota shares among their individual members. However, an equitable method of allocating among cooperatives is still required. If quota shares are granted to communities, allocations might be based on the historic landings made in those communities and/or the pooled catch histories of the communities' residents. A variety of other formulas might be developed to meet particular social and economic objectives. Under the western Alaska Community Development Quota (CDQ) program, allocations to CDQ groups are not fixed in order to allow flexibility in directing benefits and achieving community development goals. In such an arrangement, it is of paramount importance that the process for allocating community quotas be stable and transparent (National Research Council, 1999).

12/ Section 304(d) of the Magnuson-Stevens Act places strict limitations on fees that can be levied on the fishing industry. These limitations effectively preclude auctions or other means of collecting some of the rents that may be created with ITQs (Anderson, 1992).

Whether quota shares are allocated to individuals, cooperatives or communities, it may be prudent to put in place mechanisms that will allow the nature of the fishing privileges to be altered. A stable set of privileges and responsibilities with a long time horizon is important to promote the efficiency and stability of the fishery, but it is also important to maintain administrative flexibility for unforeseen eventualities that may oblige changes in the distribution of quota shares. One such mechanism discussed by the National Research Council (1999) is referred to as the Australian drop-through system. In this system, initial entitlements are defined and fixed for a long but finite period: 30 years in certain Australia fisheries. Periodically, perhaps every ten years, a comprehensive review of these entitlements takes place and changes can be made to the set of rights and obligations. Share holders can switch to this new set of entitlements (whatever is currently on offer) any time before the term of their old entitlements expire, at which time they would automatically exchange entitlements for the current set on offer. Switching to the new entitlement package locks in the right to guard those entitlements for the remaining life of that entitlement. Other systems of balancing stability with flexibility are possible. The most important element is to strike the proper balance to protect the health and prosperity of the fishery and the authority of regulators to make appropriate management decisions in the best interest of the public.

4.4.5.10 Effects on Management and Enforcement Costs

This alternative would be expected to notably increase management and enforcement costs for initial start up and over the long term. The sector allocations required by this alternative would take two to four years to develop, analyze and implement through the Council and NMFS management processes. However, certain other management costs would be reduced, particularly those associated with inseason catch projections.

Experience with the ITQ programs in fisheries around the world indicates that such programs typically result in substantial increases in the costs of monitoring, enforcement and administration. If ITQs and/or other rights-based systems are implemented in the West Coast groundfish fisheries, NMFS will be required to manage increasingly small blocks of fish. It will be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches of a large number of individual vessels. Under Alternative 5, 100% observer coverage is used to monitor the harvest of each participant and ensure that the harvest does not surpass the individual's current quota level. Even if the costs of this expanded observer coverage are largely borne by industry, the NMFS groundfish observer program can expect to see an increase in overall annual costs as a result of the increase in the number of observers and its associated increase in the amount of data collected. This budgetary increase can be attributed to additional staffing and augmented spending for data entry contracts. To monitor the catch of each vessel requires the use of increasingly sophisticated catch-monitoring tools, such as electronic reporting. With transferability, it will also be necessary to keep track of the current amount of quota owned or leased by each participant. Though computerized systems of electronic reporting and data management increase the quantity, quality, and timeliness of the information available for fisheries management, they also increase the demands on management staff to effectively make use of a larger and more complex data system. These additional costs to the monitoring program are likely to be substantial.

Lastly, a rights-based management system requires additional agency resources to develop the process through which fishing rights are assigned and to adjudicate appeals about the assignment of fishing rights to individuals or groups.

The Magnuson-Stevens Act provides for cost recovery measures that can impose a fee on quota holders of up to 3% of the ex-vessel value of IFQ landings. Total fee collections cannot exceed the annual cost of management and enforcement. Such measures were implemented for the Alaska sablefish and halibut IFQ program in 2001. Seventy-five percent of fee payments are deposited in the Limited Access System Administrative Fund and made available to NOAA Fisheries to offset costs of management and enforcement of the halibut and sablefish IFQ program.

4.4.6 Social and Economic Impacts of Alternative 6 (Marine reserves, individual caps and full retention)

Social and Economic Impacts of Alternative 6 (Marine Reserves and Vessel Quotas)

This alternative includes a wide array of measures to reduce bycatch, including a 100% groundfish retention requirement, marine protected areas and transferable restricted species quotas (RSQs) for overfished species, and transferable individual fishing quotas (ITQs) for other groundfish species. The mixture of measures complicates an analysis of the economic impacts of the alternative because the economic effects of some measures may be offsetting. For example, the decrease in costs that commercial harvesters are expected to experience under an ITQ program may render them better able to sustain possible reductions in harvests and revenues caused by the establishment of marine reserves (large portions of which are assumed to be set aside as no-take areas). However, in most cases there is insufficient information to determine the net economic effect of multiple management measures on various components of the human environment.

4.4.6.1 Effects on Fishers' Incentives to Reduce Bycatch

This alternative represents both a traditional "command-and-control" approach to reducing bycatch, and a "market-based" approach that removes the economic incentives that lead to bycatch. Marine reserves would prohibit fishers from fishing in certain areas in order to reduce the probability that fish will be caught and discarded, while the 100% retention requirement would be the primary means of reducing bycatch outside of marine reserves. Forbidding discarding produces a strong incentive to develop and apply more selective gear because the costs of sorting, storing, transporting and disposing of fish that cannot be sold may be substantial. In addition, Alternative 6 is similar to Alternative 5 in that individual commercial groundfish vessels would be assigned transferable restricted species quotas (RSQs) for overfished species and transferable individual fishing quotas (ITQs) for other groundfish species. As described in the effects analysis for Alternative 5, RSQs and ITQs provide an economic incentive to avoid catching overfished species and unwanted fish if an effective monitoring and enforcement program is in place.

4.4.6.2 Effects on Commercial Harvesters

Under this alternative, there are both measures that may significantly increase and decrease fishing costs. The level of these increases and decreases and extent to which they may be offsetting is uncertain. The 100% groundfish retention requirement as well as the establishment of marine reserves are likely to increase average costs, whereas the establishment of ITQs for groundfish species is likely to reduce costs and increase revenues.

The establishment of ITQs for groundfish species is expected to reduce the costs of harvesting (See Alternative 5 discussion of economic impacts on commercial harvesters). Individual vessels will have the opportunity to select the least-cost combination of fishing inputs. At the industry level, costs will fall because production is expected to shift over time toward the most cost-effective harvesting operations. Fixed costs will be reduced by consolidating harvesting operations and retiring or selling off vessels. These cost savings will depend both on the constraints put on the transfer and consolidation of harvesting rights and on the level of excess capacity prior to implementation of a rights-based system. Cost savings will also depend on the ability of harvesters to catch and sell a greater percentage of a particular species during periods when the species aggregate.

As discussed in Alternative 5, a rights-based system is also expected to increase exvessel revenues. Currently, a landed catch OY may be set below the ABC to account for the expected bycatch. Under Alternative 6, this reduction would not be necessary because all catch mortality would be counted against each vessels catch/mortality quotas and measured through expanded observer coverage. Consequently, the total amount of fish available for harvest would increase.[13/]

These economic benefits must be weighed against the additional operating costs that vessel owners would incur from the expanded observer coverage required under a rights-based system (See Alternative 4 discussion of effects of increased observer coverage on commercial harvesters). The increase in net revenues that commercial harvesters would be expected to experience under a rights-based system may render them better able to sustain the costs of an observer requirement. However, even if the economic benefits of a rights-based system were fully realized, it is likely that paying observer costs would not be economically feasible for many vessels due to their inability to generate sufficient cash flow to cover the added expenses. As noted in the effects analysis for Alternative 4, the installation of video cameras on board vessels to document activities at sea has the potential to substantially reduce the costs of monitoring catch and discards. While further testing of the effectiveness of

13/ Assuming that fishery managers have been risk averse when estimating discards under the *status quo*, it is likely a system of accurate accounting of discards in the groundfish fisheries would allow fishery managers greater certainty in setting ABCs and OYs.

video monitoring is needed, it should be noted that the 100% groundfish retention requirement may enhance the practicality of this type of electronic monitoring technology (Appendix C).

The 100% groundfish retention requirement could also have a positive or negative effect on the commercial harvesting sector depending on 1) how much the fish formerly discarded would decrease the vessel hold space available for more valuable product and 2) the revenue earned from product derived from the additional fish retained. Revenue per trip may decrease if a large of amount of hold space is taken up by lower-valued fish. Vessels may offset some lost revenues by taking additional fishing trips. However, the number of trips vessels can make would be strictly limited by the catch allowance for overfished groundfish species. When the catch allowance is reached, a vessel must stop fishing unless additional RSQ shares are obtained. It is also possible that markets could be expanded for some groundfish species that currently fetch lesser prices. However, the prospect of market development is uncertain.

The problem of damage to target species by mixing wanted and unwanted groundfish in the hold may be a problem for some vessels. For example, dogfish sharks have high levels of urea (or more generally, non-protein nitrogen - NPN - compounds) in their flesh and when the shark dies bacteria rapidly convert this to ammonia, contributing to spoilage. This problem may be avoided if sharks are segregated in a separate hold. However, most vessels are unlikely to be able to dedicate an entire hold to the dogfish sharks that are taken. The problem of contamination of target catch could also be avoided by on-board processing of the sharks in order to remove as much of the NPN compounds as possible. However, the costs involved in processing and preserving dogfish shark meat currently outweigh the revenue that might be garnered from doing so. For some species there is currently no established market. If vessels cannot sell the additional fish retained, they may face delivery costs for shipment to a disposal site. Smaller trawl vessels may be disproportionately affected by the groundfish retention requirement, as they are more likely constrained by hold space during a fishing trip.

The possible spatial displacement of fishing effort resulting from the establishment of marine reserves may also have a negative economic impact on many fishing operations. Displaced fishers would have the option of relocating their fishing activities to groundfish grounds that remain open.

However, open areas may be less productive, and competition for remaining good fishing locations would increase. Consequently, catch rates will likely fall, translating into less harvesting revenue for any given effort level. In addition, the area closures may force some fishers to travel further than previously, increasing operating costs.

The marine reserves established under this alternative could also cause product quality to decline. It is reasonable to assume that, subject to regulatory constraints, harvesters target certain species in areas that maximize value either by increasing the quality of the fish or by decreasing the harvesting cost or both. Consequently, a measure that prohibits vessels from using historical fishing grounds may result in a decline in product quality (e.g., fish may be smaller or a less uniform size). In addition, the quality of some groundfish species may deteriorate as the time from harvest to processing lengthens. To the extent that the establishment of marine reserves results in vessels traveling farther distances from processors, and thereby lengthening the time between harvest and processing, the quality of product would be adversely affected.

On the other hand, marine reserves have the potential to enhance exploited populations and benefit fisheries by 1) dispensing larvae that replenish fishing grounds removed from marine reserve source populations; 2) exporting biomass to adjacent fishing grounds in the form of emigrating juveniles and adults; and 3) protecting portions of exploited stocks from genetic changes, altered sex ratios and other disruptions caused by selective fishing mortality (Murray et al., 1999). These benefits could potentially mitigate, in part, deleterious effects of overfishing and restore, stabilize, or enhance fishery yields for some stocks (Dugan and Davis, 1993). In addition to higher catches, possible gains to the groundfish fisheries from marine reserves include reduced variability of catch and reduced probability of fishery closures due to overfishing (Thomson, 1998). However, it should be noted that even if marine reserves have the potential to have a positive effect on fish populations and fishery productivity, it may take several years after the area closures are established for this effect to be realized. For example, considering the longevity and erratic recruitment of many rockfish, it might be decades before marine reserve benefits to rockfish stocks and outside fisheries are demonstrated (Yoklavich, 1998 cited in Murray et al., 1999). Given this time lag, it is improbable that the potential economic benefits of marine reserves would accrue to the current generation of groundfish fishers. Even if the lag is considerably shorter, it is likely to be perceived as too long for most fishers whose social and economic well-being is contingent on shorter schedules (Murray et al., 1999).

Reductions in fishery landings associated with the establishment of marine reserves and the resulting social and economic adjustments required by fishers may be partially mitigated by phasing in marine reserves to distribute the loss of fishing grounds and related catches throughout several years. During this period, the benefits obtained from marine reserves may begin to offset losses due to displacement of fishing activities (Sladek et al., 1997 cited in Murray et al., 1999).

4.4.6.3 Effects on Recreational Fisheries

An IFQ program would not apply to the recreational fishery, and an IFQ would not necessarily result in any change in the proportion of the total groundfish catch taken by or allocated to the recreational sector. However, in order to protect the IQ shares for the commercial fleet, Alternative 6 would require establishment of hard caps (catch limits) for the recreational fishery similar to or the same as those in Alternatives 4 and 5. In this respect, Alternative 6 may have a negative economic effect on recreational fishers relative to the status quo. A closure of the recreational fishery due to reaching its allocation would result in fewer fishing experiences for private anglers and charter fishing patrons. Dividing the recreational sector into geographic (e.g., state-based) subsectors could mitigate some of the negative effects.

Alternative 6 also includes the measure of establishing no-take reserves, which will create additional impacts. As with commercial fishers, participants in recreational fisheries could potentially benefit over the long term from increases in local catch rates and fish size due to spillage of adults out of the marine reserves (Parrish et al., 2001).

On the other hand, if the establishment of marine reserves results in a geographic redistribution of the commercial and recreational fleets, the concentration of fishing effort in the areas that remain open may lead to localized depletion of stocks and a decline in catch per unit effort and individual harvests. Lower individual catches would mean a reduction in the quality of the fishing experience to a number of recreational fishers and charter fishing patrons. The value of the fishing experience would be further reduced if marine reserves increase the distance that recreational fishers must travel to reach productive fishing grounds.

While not completely immobile with respect to a port of operation, charter boat operations are location dependent both in terms of their reliance on location-specific marketing channels to bring them customers, and the effects of distance to fishing grounds on profit (Parrish et al., 2001). Increased distance to fishing grounds may affect both the cost and revenue side of their profit function (increased distance and travel time increases the fuel and labor opportunity costs and at the same time would likely decrease willingness of customers to take a trip). Charter vessels that work as independents rely on charter offices to book their clients, and have somewhat more locational flexibility than those vessels that serve as their own booking agents. Charter booking offices, on the other hand, are more closely tied to the fishing opportunities available in the port that they serve.

Recreational fishers would face the same situation as described for charter vessels except that recreational fishers may be more mobile in their choice of fishing ports (Parrish et al., 2001). The likelihood that fishers would change fishing ports depends on the degree to which fishing is the primary purpose of a trip and the distance to alternative ports.

4.4.6.4 Effects on Tribal Fisheries

The individual vessel catch limit provisions of Alternative 6 would not change any Tribal allocations. If Tribal fishers were included in the ITQ program, or allowed to purchase ITQ from non-tribal fishers, they would receive similar benefits. In this respect, Alternative 6 is expected to have a minimal economic effect on tribal groups. The coastal Treaty Tribes have negotiated allocations of sablefish and Pacific whiting, and there are several other groundfish species taken in Tribal fisheries for which formal allocations have not been established. Allocations of these species could be negotiated in a similar manner.

Any marine reserves that overlap usual and accustomed (U&A) fishing areas would have to be approved by the Tribes or would not apply to Tribal fishers. Fishing restrictions in marine reserves could conflict with federally recognized treaty rights of tribes to fish in their U&A fishing areas (Parrish et al., 2001). Under these circumstances, it may be possible that NMFS and tribal authorities could negotiate a “co-management” arrangement whereby tribes were granted preferential access to marine reserves for selected purposes and certain responsibilities related to marine reserve management were delegated to the tribes.

4.4.6.5 Effects on Buyers and Processors

As with commercial harvesters, the net economic effect of Alternative 6 on buyers and processors is uncertain. In general, buyers and processors are expected to benefit from the anticipated increases in fish landings that result from the implementation of a rights-based system. The 100% retention requirement could also result in a large increase in landings. However, it is uncertain how much of the additional fish retained would be marketable. While some fish are currently discarded because trip limits are exceeded, other fish are discarded for economic reasons. It is likely that over time buyers and processors will be able to develop new markets and expand existing markets to more fully absorb the increased supply of groundfish that would be associated with 100% retention in the groundfish fisheries. At a minimum, some processors already have the capability of processing low grade fish as fish meal. There may be concerns that increased retention will overwhelm existing infrastructure and supplies of potable water (Radtke and Davis, 1998). However, it is expected that over the long term processors will be able to carry out the market development, structural changes and operational adjustments required to accommodate the additional groundfish retained. To facilitate this transition, a multi-year "phase-in" program for retention of groundfish could be adopted. For example, the program could start at 25% retention the first year and increase in fixed increments over subsequent years until 100% retention is achieved.

Because of their lack of mobility, we would expect the possible negative impacts of Marine reserves on buyers and processors to be greater than the impacts on fishers as a group. However, the effects of Marine reserves on specific buyers and processing companies will depend in part on changes in local supply and how processors have adapted to current supply situations (Parrish et al., 2001). Processors that have continued to rely on local supply to maintain operations at a particular plant will be most affected by any change in local supply. Processors that have adapted to current fishery conditions by centralization of processing and distribution activities may be somewhat less affected. By shipping raw product to centralized locations, these processors are able to maintain a more consistent product supply and better utilize their factory capital and work force. They are likely to be less affected by localized disruption in supply, but will still be affected by Marine reserves that change the total amounts of fish available for harvest.

4.4.6.6 Effects on Communities

The effects on communities of implementing a rights-based management system in the groundfish fisheries are described in Alternative 5. The establishment of marine reserves would create additional impacts. Marine reserves would be expected to have a positive effect on the long term productivity of groundfish stocks, which affects the abundance of fish in the future. Consequently, this measure could help ensure harvests for future generations and the sustained participation of communities in groundfish fisheries. If, however, marine reserves resulted in substantial decreases in groundfish catches over the short term, the economic hardships that fishing families and other members of West Coast fishing communities are experiencing under the *status quo* would be worsened.

4.4.6.7 Effects on Consumers of Groundfish Products and Other Segments of the American Public

Consumers would also be expected to benefit from the anticipated increases in fish landings that result from the implementation of a rights-based system. In addition, over the long term, marine reserves that effectively increase the size and variety of seafood species could make consumers better off. On the other hand, large marine reserves could substantially decrease seafood supply enough to make consumers worse off, at least in the short term (Carter 2003). Both the intensity of this negative effect and the probability of its occurrence are uncertain. The most likely result of a decrease in the groundfish catch would be a negative effect on the U.S. seafood trade balance, as more groundfish products would be imported to offset the reduced domestic supply. For example, similar products from South America, Mexico and Canada could potentially substitute for West Coast production.

The price elasticity of demand for groundfish products is fairly high in the U.S. market, but assuming that demand is not perfectly elastic, the decreased production could result in higher product sales prices and a loss of consumer surplus (i.e., net benefits) to the American public. The magnitude of that loss would depend on price elasticities that are not quantifiable at this time and on the degree to which production shifted toward or away from the export markets.

Marine ecosystems and species associated with them provide a broad range of benefits to the American public (National Research Council 2001). Some of the goods and services these ecosystems produce are not exchanged in normal market transactions but have value nonetheless. For example, in addition to supporting commercial fisheries, these ecosystems support an array of recreational fishing and subsistence activities as well as non-consumptive activities such as wildlife viewing and research and education (Carter 2003; Parrish et al. 2001). Furthermore, some people may not directly interact with the marine environment, but derive satisfaction from knowing that the structure and function of that environment is protected.

A primary result of this alternative would be to provide increased protection for habitat and the overall ecosystem. In particular, the marine reserves increase protection for a large number of species and their interrelationships and provide for the maintenance of natural processes. In turn, these positive effects on marine ecosystems and associated species would be expected to lead to a significant increase in the levels of the range of benefits these ecosystems and species provide. However, changes arising from no-take reserves are difficult to predict and cannot be quantified at this time. Further research in these effects is needed.

It is also important to note that some individuals may hold religious or philosophical convictions that humankind has an ethical obligation to preserve species and ecosystems, notwithstanding any utilitarian benefits. While additional surveys and polls are needed to better understand the values and motives underlying public support of measures that protect marine species and ecosystems, Parrish et al. (2001) note that a 1999 survey conducted by the Mellman Group for SeaWeb found a high level of approval for the establishment of marine reserves. Seventy-five percent of the individuals surveyed favored having certain areas of the ocean as protected areas; 60% believed that there should be more marine sanctuaries; and 3% believed there were already too many marine sanctuaries. Survey respondents cited the following as "convincing" reasons for creating MPAs: 1) distinctive areas should be protected similar to what is done for national parks (65%); 2) less than 1% of U.S. waters are in MPAs (63%); 3) MPAs would be an important step in improving the health of oceans (58%); 4) harmful activity should be restricted to preserve ocean beauty for future generations (57%). Support for MPAs diminished by only 1% when respondents were first read a statement outlining potential negative socioeconomic effects of creating MPAs and increased by 6% when respondents were first read a statement outlining potential positive effects of creating MPAs.

4.4.6.8 Effects on Fishing Vessel Safety

The establishment of ITQs for groundfish species would be expected to promote vessel safety compared to the *status quo* by reducing the pressure to fish under dangerous conditions and increasing the ability of fishers to pay for vessel maintenance and safety equipment (See Alternative 5 discussion of fishing vessel safety). On the other hand, the establishment of marine reserves may result in a reduction in fishing vessel safety (compared to the *status quo*) if the closure of fishing grounds results in vessels fishing farther from port and possibly in more hazardous areas. The adverse effects on safety of human life at sea would be more extreme for smaller vessels. For example, recreational boats are typically smaller than commercial or charter boats, and, if marine reserves force recreational boats to travel greater distances or further offshore, risks to this group could increase substantially. The net effect of the various measures on fishing vessel safety is uncertain.

4.4.6.9 Effects on Management and Enforcement Costs

The tracking, monitoring and enforcement activities associated with a rights-based system are expensive (See Alternative 5 discussion of management and enforcement costs). Full (100%) observer coverage would be used to monitor the harvest of each participant and ensure that all catch and bycatch is monitored and recorded. This level of observer coverage would also facilitate enforcement of a full retention regulation. Any observed discarding of groundfish would be an offense. A possible concern to NMFS is the implications of having observers directly involved in monitoring compliance with discard restrictions. Doing so may require observers to assume an enforcement role that is not consistent with current objectives of the groundfish observer program.

According to Parrish et al. (2001), the enforcement costs of establishing MPAs will vary with the following factors:

1) the number, size, and shape of the MPAs;
2) types of activities restricted and allowed;
3) degree of change the MPAs require as compared to current usage of the area;
4) proximity of the MPAs to other activities such that public surveillance can occur or there will be an enforcement presence in the area for other reasons; and
5) the types of activities enforcement is diverted from in order to enforce MPAs (unless new funds are made available for enforcement).

The costs of enforcing marine reserves and other MPAs have been declining due to the decreasing costs of technologies such as vessel monitoring systems (VMS) (See Alternative 1 discussion of management and enforcement costs).

Restricting recreational fisheries in MPAs would increase regulatory complexity and the monitoring and enforcement costs associated with these fisheries. Although many recreational vessels carry the necessary electronic equipment to chart their location, monitoring compliance in the recreational fisheries may be costly. Unless VMS requirements were extended to include recreational vessels, the existing methods of patrolling sea areas either by airplane or ship would have to be used to monitor and enforce closed areas. At-sea monitoring would be more expensive and less effective than using VMS.

Comprehensive baseline and post-implementation studies of marine reserves are necessary to determine their biological effects (Parrish et al., 2001). The costs of monitoring MPA effectiveness are difficult to evaluate at this general level of discussion and will primarily be dependent upon the number and size of reserves and the number of significant types of habitat encompassed in the marine reserves. As an example of expected costs, $80,000 was spent for a one-time only survey of the bottom habitat in deep water (25 m to 100 m) inside and outside the Big Creek Ecological Reserve off central California; this represented about 25 square kilometers of total study area (Parrish et al. 2001). An additional $300,000 was spent to collect baseline information on fish abundance, diversity, and size composition in and out of the reserve in deep water over two years following establishment of the reserve. Parrish et al. (2001) note that with larger MPAs, there is potential for using cooperative industry/agency research platforms for extractive monitoring.

An expanded port/field sampling program to improve estimates of recreational catch would entail a larger budget for the state and federal agencies currently involved in data collection. The current program recently received additional funds so that its 2004 total budget is about $3.4 million ($2.2 million in federal dollars and $1.2 million from Oregon, Washington and California). However, it estimated that the program would require an additional $1 million to develop a comprehensive coastwide marine recreational fisheries data collection system (Russell Porter, PSMFC, pers. comm., Oct. 30, 2003).

4.4.7 Data Gaps and Information Needs

As discussed previously, there may be insufficient information to comprehensively assess the economic consequences of existing or expanded measures to mitigate bycatch in the groundfish fisheries. This section will outline the data requirements needed to frame a more complete economic impact assessment.

The following quantitative data would support the analysis of the economic effects of the alternatives. In some cases, time series data would be useful to compare the economic status of the groundfish fisheries before and after implementation of existing management measures that have affected the level of bycatch. This data would also provide a benchmark that would allow before-and-after comparisons if alternative measures are implemented.

- Estimates of excess harvesting and processing capacity (including latent capacity of inactive vessels) derived from information on the quantities of capital equipment purchased and maintained by plants and vessels, their activity levels in various fisheries, and variable input use (for items such as labor, fuel fishing gear and other essential inputs). These estimates should be by sector and vessel length category.
- Average sale price of groundfish license by vessel designation, length category, gear type and area endorsement, 1995-2001.
- Estimates of the economic effects of groundfish bycatch in groundfish and other fisheries using "bioeconomic" multi-species models that incorporate data on biological interactions, effort levels, catch and bycatch rates, and catch values.
- Model-based estimates of the economic effects of introducing ITQs in the fisheries, including changes in the size, structure, location and profitability of the fleet.
- Information on the current economic performance of the fleet and individual vessels and processors, including disaggregated income, cost and employment information from harvesting and processing firms.
- Vessel and processing facility ownership data to monitor changes in concentration of ownership in the harvesting and processing sectors, the structure of ownership (including proprietorships, publicly traded corporations and privately held corporations) and the relationships both within firms (i.e., the amount and nature of vertical and horizontal integration) and among firms.
- Data to measure the willingness to pay (demand) for recreational fishing experiences of varying quality.
- Data on the relative economic importance of fisheries (salmon, crab, groundfish, and pelagic species) to individual fishing vessels and processing companies in various ports, and information on the amounts of product processors acquire from local and outside sources.

- Model-based estimates of the economic effects of establishing marine reserves using information on the location and magnitude of current harvest and effort, travel costs to different fishing grounds and the extent to which fishermen can relocate to other areas.
- Estimates of the existence value and other non-consumptive values attributed to resources within proposed marine reserves.
- Information on the dependence of families in various communities on income from fishing, alternative sources of income, and resources available in communities to assist families in adapting to change.
- Information on the costs and effectiveness of alternative onboard electronic monitoring technology to monitor catch and discards, including video recording devices.
- Information on the costs and effectiveness of alternative industry reporting and recordkeeping requirements to monitor catch and discards, including vessel logbooks.

4.5 Summary of Impacts of Alternative Monitoring Programs

Data Reporting, Record-keeping, and Monitoring are summarized in Table 4.5.1 and briefly described below:

1. **Alternative 1** 10% coverage of commercial fleet, 100% coverage of at-sea whiting catcher/processor fleet.
2. **Alternative 2** Same as Alternative 1, except some marginal increase in coverage due to fewer vessels.
3. **Alternative 3** Same as Alternative 1, except some marginal increase in coverage due to fewer trips**.**
4. **Alternative 4** Significant increase in observer coverage with allocation to fleet sectors, mandatory logbooks, increased recreational sampling
5. **Alternative 5** 100% observer coverage of commercial fleet and charter boats.
6. **Alternative 6** 100% observer coverage of commercial fleet and charter boats.
7.

Effectiveness of tools to improve accountability are ranked by alternative in Tables 4.5.1 and 4.5.2

Overfished Groundfish

Under the Alternative 1 sampling program, total catch estimates of overfished species are highly variable for several reasons. Most of the species are highly aggregating rockfish and population abundance is low, thus tow by tow variability is quite high. The sampling program was initiated in the fall of 2001 and depends on accumulation of observed tows to stabilize variability (NMFS 2003). A complete estimate cannot be made until after logbook and fish ticket data are acquired, some months after the fishing season is over. Status quo monitoring improves previous estimates of bycatch that are based on dated studies. In spite of sampling limitations, these estimates better reflect current population levels, management, and fishing strategies.

Amendment16-2 (PFMC 2003c) discusses status quo bycatch monitoring of overfished species (see section 4.3.1.2). One of the primary concerns with bycatch monitoring is that rebuilding of overfished species is sensitive to actual bycatch rates. Total catch must be accounted for accurately for rebuilding to be successful. Under status quo, observer coverage is available for about 10% of the commercial fleet (100% of at-sea Pacific whiting catcher processors have observer coverage). As was pointed out in the Amendment 16-2 EIS, if bycatch estimates are underestimated, rebuilding progress will be compromised (PFMC 2003c). On the other hand, if they are overestimated, trip limits and available harvest of overfished and healthy stocks of groundfish will be lower, bycatch and bycatch mortality will be higher, and there will be indirect negative socioeconomic impacts. Low OYs for some species make it imperative to improve accounting of catch and bycatch.

Alternatives 2 and 3 assume the same number of observer days would be applied to fewer trips due to either a reduced fleet size (Alternative 2) or reduced season (Alternative 3). This would have the effect of increasing the proportion of total trips having observer coverage. Some marginal improvements should occur in tracking of overfished species.

In Alternative 4, observer coverage would be significantly increased along with cost compared to Alternatives 1-3. Observers would be placed on a subset of each sector, and observed catch rates extrapolated (expanded) to the entire sector. Recreational sampling would also be increased under this alternative. In-season monitoring of commercial and recreational fisheries would ensure caps would not be exceeded by any given sector. These controls would have a direct effect of reducing bycatch of overfished species compared to the first three alternatives. Bycatch mortality of overfished species may also be reduced in the commercial fishery compared to the first three alternatives, as fishers are likely to retain catches.

Table 4.5.1. Monitoring tools and effects on improving accountability and cost impacts of each tool. Effects scaled as follows: Y (definitely, substantially), y (probably, moderately), n (probably not, minor), and N (no, none); L = lower cost, M = moderately higher cost, H = highest cost.

Monitoring/Reporting Requirements	Alternatives	Program	Identify fishing locations	Identify fishing depths	Provide tow by tow data	good data quality	Increase quantity and timeliness of data	Identify groundfish discards	Provide groundfish biological data	Provide non-groundfish data	Provide other non-finfish data	Provide mammal and seabird data	Ease of enforcement	Administrative Costs	Compliance Costs (to industry)
fish tickets	1-6	state	N	N	N	y	Y	N	N	y	N	N	Y	L	L
logbooks	1-2,4-6	state	y	y	y	y	n	N	N	N	N	N	Y	M	M
logbooks	3	federal	y	y	y	y	y	y	N	N	N	N	Y	M	M
observers															
commercial 10%	1-3	federal	Y	Y	Y	Y	n	Y	Y	Y	Y	Y		H	M/H
commercial 60%	4	federal	Y	Y	Y	Y	y	Y	Y	Y	Y	Y		H	M/H
commercial 100%	5,6	federal	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		H	M/H
CPFV	4-5	(state)	Y	y	-	Y	Y	Y	Y	Y	Y	y		H	M/H
sport		n/a			-		-							HH	
port sampling															
commercial	1-6	state	y	y	N	Y		n	y	N	N	N		M	L
CPFV	1-6	state	y	y	-	Y		n	y	y	N	N		M	L
sport	1-6	state	y		-				y?	y?				M/H	L
VMS	1-6	federal	Y	y	N	Y	Y	N	N	N	N	N	Y	L	M
mandatory retention	5,6	federal				Y	Y	y	y	n	n	N	N	H/M	M/H
Enforcement cost			H	H	H			H		H	H				

Table 4.5.2 Monitoring alternatives and rank of effects on improving accountability, and cost impacts of each alternative.

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
RELATIVE RANK OF ALTERNATIVES BY EFFECTIVENESS AT IMPROVING ACCOUNTABILITY, EASE OF ENFORCEMENT, REDUCING COMPLIANCE COSTS	10% commercial observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and pre-season estimates of discard, no in-season commercial observer data, VMS.	10% commercial observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and pre-season estimates of discard, no in-season commercial observer data, VMS.	10% commercial observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and pre-season estimates of discard, no in-season commercial observer data, 100% log coverage, log verification, VMS.	60% commercial and recreational (CPFV) observer coverage, increased commercial and recreational port sampling, catch projections based on fishtickets and some in-season estimates of discard and in-season observer data, VMS.	100% commercial and recreational (CPFV) observer coverage, commercial and recreational port sampling, catch projections based on fishtickets and some in-season estimates of discard and in-season observer data, VMS.	100% commercial and recreational (CPFV) observer coverage, commercial and increased recreational port sampling, catch projections based on fishtickets and some in-season estimates of discard and in-season observer data, VMS.
Indentify fishing locations (VMS)	1	1	1	1	1	1
Identify fishing depths (VMS)	1	1	1	1	1	1
Provide tow by tow data	2	2	1	1	1	1
Provide good quality data	4	4	3	2	1	1
Increase quantity of data	5	4	3	2	1	1
Allow inseason use of data	3	3	3	2	1	1
Identify groundfish discards	5	4	3	2	1	1
Provide groundfish biological data	6	5	4	3	2	1
Provide non-groundfish biological data	3	3	3	2	1	1
Provide non-finfish biological data	3	3	3	2	1	1
Provide mammal and seabird data	3	3	3	2	1	1
Ease of enforcement	5	4	3	2	1	1
Keep administrative costs low	2	3	4	5	6	6
Keep industry compliance costs low	2	3	4	5	6	6
Rank of location	2	2	1	1	1	1
Rank of quality, quantity, timeliness	5	4	3	2	1	1
Rank of groundfish biological data	6	5	4	3	2	1
Rank of non-groundfish biological data	3	3	3	2	1	1
Rank of ease of enforcement	5	4	3	2	1	1
Rank of cost	1	2	3	4	5	5
Number of first place scores	2	2	4	4	15	17
Number of last place scores	15	8	5	0	3	3
Overall Rank	6	5	4	3	2	1

Alternatives 5 and 6 provide 100% coverage of the commercial fleet and increased monitoring of the recreational charter boat fleet. In-season monitoring of commercial and recreational fisheries would ensure caps would not be exceeded by any given fishing vessel. These controls would have a direct effect of reducing bycatch of overfished species compared to the first four alternatives. Bycatch mortality may also be reduced in the commercial fishery compared to the first four alternatives, as fishers are more likely to retain catches.

Although coverage of the charter boat fleet is increased, some bycatch mortality of rockfish caught and released in the recreational fishery would occur. Bycatch mortality of lingcod is thought to be less than for rockfish as lingcod do not possess a swim bladder.

Costs for Alternatives 5 and 6 are significantly higher than Alternatives 1-3 and somewhat higher than Alternative 4.

<u>Emphasis Species</u>
Several species of groundfish co-occurring with overfished species or species under precautionary management are constrained in an effort to control harvest of species of concern. Ratio management seeks to predict catch of overfished species and those under precautionary management relative to target species in order to scale and proportion trip limits. Under Alternative 1, if observer coverage and monitoring efforts result in over estimation of the bycatch of overfished species or species under precautionary management, trip limits for healthy stocks such as shelf rockfish, Petrale sole, Dover sole, sablefish, and longspine thornyhead could be constrained more than they need to be (see discussion above under <u>Overfished species</u>) resulting in an increase in bycatch and bycatch mortality as well as negative socioeconomic impacts. Nevertheless, it is critical to improve estimates of catch and bycatch in order to provide accurate catch ratios and set trip limits that reflect these ratios. Currently, there is evidence that catch ratios may not reflect reality. For example, Dover sole discard rates are estimated to be only 5%, and most of the OY is taken by the trawl fishery for DTS complex. On the other hand, sablefish and longspine thornyhead harvest is lower than OY. Discard rates are comparatively high for shortspine thornyhead, to the point that OY may be exceeded. All of these observations suggest that the ratios do not reflect reality, and that better information is needed (see discussion above under **Trip limits**).

As was described above under overfished species, Alternatives 2 and 3 should have a positive impact on catch reporting of other groundfish as compared to Alternative 1. Discard information on other healthier stocks of groundfish may be improved. Currently, observers do not always collect data on the reasons for discarding fish. Managers may want to consider allocating some of time spent accounting for overfished species and other groundfish (ratio estimation) towards gathering additional important data on the reasons for discard.

Alternative 4 would improve reporting of catch over the previous three alternatives and should produce more precise information about regulatory, size, and market induced discard of other groundfish. The improved information should have a positive indirect impact on stock assessments of other groundfish.

Discarding of other groundfish would still be legal under Alternative 5 but not Alternative 6. Some nearshore species (such as black rockfish and cabezon) could still be discarded by nearshore commercial and recreational fleets. Thus, the monitoring program under Alternative 5 may be slightly less effective than under Alternative 6 (See gray shaded box under monitoring column in Table 4.3.5). Full (100%) observer coverage of the limited entry commercial fleet and increased coverage of the open access and recreational fleets would provide better data on total catch of other groundfish, including discards. These alternative should substantially improve information and accountability compared to the first four alternatives. Another impact of 100% observer coverage would be very timely and accurate accounting of most of the catch. Indirect impacts of 100% observer coverage would include improved stock assessments and improved data on reasons for discard that may led to new methods of avoiding bycatch.

Potential impacts to the resource due to bias in catch estimates are thought to be minimal for more abundant species such as petrale sole and English sole, as current exploitation rates are thought to be low, thus catch and bycatch are low with respect to OY.

4.6 Summary of Impacts to Biological Environment

Alternatives range from status quo, the no action Alternative1, to Alternative 6, characterized by marine reserves, catch caps in the form of IFQs, full retention of groundfish, and an intensive monitoring program. Different approaches are used to address bycatch, bycatch mortality, and to increase accountability. Some are likely to be more effective at reducing bycatch compared to Alternative 1 but at an increased cost to government agencies and users. Some alternatives may provide incentives and longer term financial security to help offset increased initial costs.

The relative effectiveness of each alternative in reducing bycatch and bycatch mortality is summarized and compared in Tables 4.6.1 and 4.6.2.. Effect on individual fisher accountability is included.

4.6.1 Summary of Alternative 1 *(No Action)*

The policy goal of Alternative 1 is to continue current fishery management provided by the FMP in a manner consistent with Council objectives of maintaining a year-round groundfish fishery, preventing overfishing, and rebuilding overfished stocks at current levels of effort. Trip limits are used to discourage fishing in certain areas based on species encounter rates of overfished species. Gear restrictions are used where possible to reduce expected bycatch rates. Marine Protected Areas (MPAs) are also used to reduce or prohibit fishing within Rockfish Conservation Areas (RCAs) on the continental shelf. Management relies on logbooks, port sampling, and partial observer coverage of the groundfish fleet.

Table 4.6.1 Relative rank of bycatch reduction methods (tools) for each alternative used to reduce bycatch and bycatch mortality, and address accountability issues.

RELATIVE RANK OF ALTERNATIVES BY BYCATCH REDUCTION TOOL TYPE	**Alternative 1** Control bycatch by trip (retention) limits that vary by gear, depth, area; long season	**Alternative 2** Reduce regulatory bycatch by increasing trip limits (reduce commercial trawl fleet)	**Alternative 3** Reduce regulatory bycatch by increasing trip limits (reduce commercial season)	**Alternative 4** Reduce all groundfish bycatch by establishing sector caps	**Alternative 5** Reduce all groundfish bycatch by establishing individual catch caps (rights-based) and individual quotas for non-overfished species	**Alternative 6** Reduce all bycatch by large area closures and gear restrictions, individual bycatch caps, and increased retention requirements
FISHERY MANAGEMENT TOOLS						
Harvest Levels						
ABC/OY based on ratios/estimated joint catch rates ("bycatch model")	1	1	1	1	1	1
Set **overfished groundfish catch caps** by **fishing sector**	2	2	2	1	2	2
Use **trip limits** to control groundfish bycatch, ratios similar to expected species encounter rates, adjusted to discourage fishing in certain areas	4	2	3	2	1	1
Use **catch limits** to control groundfish bycatch	3	3	3	2	1	1
Set individual vessel/permit catch caps for overfished groundfish species	3	3	3	2	2	1
Set groundfish **discard caps** (require increased retention)	2	2	2	2	1	1
Establish **IQs** for other groundfish	2	2	2	2	1	1
Establish bycatch **performance standards**	3	3	3	2	1	1
Establish a reserve for fishers who achieve performance standards	3	3	3	2	1	1
Gear Restricitons						
Rely on **gear restrictions** to reduce expected or assumed bycatch rates	2	2	2	2	3	1
Time/Area Restrictions	3	3	3	3	2	1
Establish **long term closures for all groundfish fishing**	3	3	3	3	2	1
Establish **long term closures for on-bottom fishing**	2	2	2	2	1	1
Capacity reduction (mandatory)	3	1	3	3	2	2
Monitoring/Reporting Requirements						
Trawl logbooks	2	2	1	2	2	2
Fixed-gear logbooks	2	2	1	2	2	2
CPFV logbooks	2	2	2	1	1	1
Commercial **port sampling**	3	3	3	2	1	1
Recreational port sampling	3	3	3	1	2	1
Observer coverage (commercial)	5	4	3	2	1	1
CPFV observers	3	3	3	2	2	1
VMS	1	1	1	1	1	1
Post-season observer data OK	3	3	3	2	1	1
Inseason observer data required	3	3	3	2	1	1
Rely on fish tickets as the primary monitoring device for groundfish landings inseason	2	2	2	2	1	1
Discount fish ticket records of overfished species landings due to the low likelihood they accurately reflect actual catch and mortality.	2	2	2	1	1	1
Number of first place scores	2	3	4	5	16	22
Number of last place scores	23	20	18	12	3	3
Overall Rank	5	4	4	3	2	1

* Trip limits may be required for some sectors to prevent "derby fishing".

Table 4.6.2 Alternatives ranked by their effectiveness at reducing bycatch, enforcing and monitoring bycatch measures, and reducing compliance costs to industry.

RELATIVE RANK OF ALTERNATIVES BY POTENTIAL BYCATCH REDUCTION, EASE OF ENFORCEMENT AND COST	**Alternative 1** Control bycatch by trip (retention) limits that vary by gear, depth, area; long season	**Alternative 2** Reduce regulatory bycatch by increasing trip limits (reduce commercial trawl fleet)	**Alternative 3** Reduce regulatory bycatch by increasing trip limits (reduce commercial season)	**Alternative 4** Reduce all groundfish bycatch by establishing sector caps and individual vessel restricted species quotas (RSQs)	**Alternative 5** Reduce all groundfish bycatch by establishing individual catch caps (rights-based) and individual quotas for non-overfished species	**Alternative 6** Reduce all bycatch by large area closures and gear restrictions, individual bycatch caps, and increased retention requirements
Reduce catch in excess of vessel limits?	5	4	5	3	2	1
Reduce proportion of overfished species?	5	3	4	2	1	1
Reduce encounters with overfished	5	3	4	2	1	1
Reduce fishing in high relief seafloor	5	3	4	2	2	1
Reduce catch proportion of on-bottom	5	3	4	3	2	1
Reduce catch proportion of off-bottom	6	4	5	3	2	1
Reduce catch proportion of small fish?	3	3	3	3	2	1
Reduce catch of unwanted finfish species?	3	3	3	3	2	1
Reduce potential for "ghost fishing"?	1	1	1	1	1	1
Reduce catch of marine mammals?	2	1	2	2	2	2
Reduce catch of seabirds?	2	1	2	2	2	2
How easily enforced/ monitored?	5	4	3	2	1	1
Compliance Costs (to vessel)	1	2	3	4	5	6
Rank of Groundfish Bycatch Reduction	6	4	5	3	2	1
Rank of Other Bycatch Reduction	2	1	2	2	2	2
Rank of Enforcement	5	4	3	2	1	1
Rank of Cost	1	2	3	4	5	6
Number of first place scores	2	3	1	1	4	10
Number of last place scores	11	2	4	4	2	3
Overall Rank	6	4	5	3	2	1

A major source of impacts to groundfish resources is regulatory discard due to tight trip limits imposed to keep overall catches within OYs. Primary affected groundfish species include overfished groundfish and highly valued groundfish with catches constrained by co-occurring overfished species limits. While current management is consistent with rebuilding strategies, a significant fraction of the overall groundfish OY is discarded or not harvested due to constraints on overfished species. Gear restrictions and RCAs reduce most fishing activities and associated bycatch impacts from large areas of the continental shelf. They also reduce the bycatch of halibut and impacts to benthic organisms. Pelagic trawling still occurs within the boundaries of RCAs and there is measurable bycatch of Pacific whiting, widow rockfish, yellowtail rockfish and prohibited species such as salmon.

Experimentation with gear designs and configurations may result in reduced observed bycatch of overfished species. The fate of fish excluded from fishing gears is largely unknown and excluded fish are likely to contribute to bycatch mortality to some degree.

Seaward and shoreward of the RCA boundaries, current management measures do not significantly affect market-induced bycatch that results from discard of undersized fish or fish having little or no market value.

Bycatch of Pacific halibut constitutes only a small proportion of overall mortality of the halibut population. Halibut may not be retained in trawl fisheries, but the trawl catch mortality does reduce the total allowable harvest for directed West Coast halibut fisheries. Impacts on salmon bycatch are also believed to be relatively minor in the groundfish fisheries.

Based on limited observations, seabird interactions with groundfish gears under Alternative 1 are thought to be quite low.

Alternative 1 includes a sampling program designed to make improvements in historical estimates of catch, catch ratios of overfished to other groundfish, and estimated bycatch. The program is designed to provide a valid scientific basis for management at a low cost, but is limited in its ability to provide in-season data.

4.6.2 Summary of Alternative 2 *(Larger trip limits - fleet reduction)*

The policy goal of this alternative is to reduce bycatch by further reducing harvest capacity and increasing trip limit size without reducing the length of the season. This is consistent with Council objectives of maintaining a year-round groundfish fishery, preventing overfishing, and rebuilding overfished stocks while holding down monitoring costs. Capacity reduction in this alternative is consistent with the Council's *Strategic Plan for Groundfish*.

This alternative is similar to Alternative 1 in that trip limits, gear restrictions, RCAs, and a low cost sampling program would be used to manage the fishery. It differs significantly in that trawl effort would be reduced compared to Alternative 1. Reducing effort would tend to make other bycatch reduction tools work more efficiently. The primary effect of effort reduction is that groundfish trip limits would be increased. Studies have shown that bycatch is inversely proportional to trip limit size. This was found to be true for especially for West Coast groundfish species of concern. The primary benefit of increasing trip limit size in contemporary management of overfished species would be to reduce regulatory bycatch. Bycatch of other high-valued but constrained groundfish would also be reduced due to the larger trip limits. Other impacts would remain largely the same as Alternative 1.

Impacts of Alternative 2 on Pacific halibut bycatch would likely remain similar to Alternative 1, due to continued use of RCAs. Impacts on salmon bycatch would be low and similar to Alternative 1.

Bird interactions with groundfish gears under Alternative 2 should be lower than under Alternative 1, due to effort reduction.

Monitoring would improve marginally under this alternative compared to Alternative 1. If the number of observer days remains the same, coverage would likely increase as a proportion of observed to total trips would increase with a reduction in effective effort.

4.6.3 Summary of Alternative 3 *(Larger trip limits - shorter season)*

The policy goal of this alternative is to reduce bycatch by shortening the commercial fishing season to achieve larger groundfish trip limits. Fleet size would not be further reduced compared to Alternative 1. This alternative is consistent with Council objectives to prevent overfishing and rebuild overfished stocks while maintaining a low cost monitoring program. It may be contrary to the current goal of maintaining a year-round groundfish fishery for individual vessels. However, if vessels are assigned to "platoons" that fish during alternating periods, year round groundfish production could be achieved.

Under this alternative, trip limit size would be increased and individual vessels' fishing time would be correspondingly shortened. Platooning of the fleet to achieve a year-round season might be possible; however, this would greatly increase the difficulty in determining appropriate trip limits for the various platoons and fishing periods. The "bycatch model" requires that fishing effort be predicted, and fleet response to this alternative would be hard to predict. This could be mitigated by requiring pre-registration or by assigning every commercial vessel to specified fishing periods. Groundfish fishing activities would likely be restricted during times when encounter rates of overfished species are higher. Reduced groundfish fishing time would result in some commercial fishers moving to non-groundfish fisheries during their "off seasons;" potential bycatch of groundfish during those fishing activities would also be difficult to predict. Without registration or assignment to specified fishing periods, accurate modeling of bycatch would be impossible.

If these problems could be overcome, the impacts on groundfish would be similar to Alternative 2.

Impacts of Alternative 3 on Pacific halibut bycatch would likely be similar to Alternative 1, due to continued use of RCAs. There is the possibility bycatch of Pacific halibut could increase if groundfish fishing increased during January through August in areas where halibut are more vulnerable to trawl bycatch.

Impacts on salmon bycatch would be expected to be low and similar to Alternative 1.

Bird interactions with groundfish gears under Alternative 3 are more difficult to predict and would depend on the timing of the fishing activities. Bird interactions would be greatly reduced or eliminated during closed periods, if periods were closed to all fishing.

Shortening the season would likely reduce the total number of trips possible within the year. If so, monitoring coverage would increase correspondingly. That is, the same number of observers days would be used to cover fewer total trips, increasing the proportion of total trips covered by observers.

4.6.4 Summary of Alternative 4 *(Sector catch limits, vessel catch caps)*

The policy goal of this Alternative 4 is to reduce bycatch by setting catch limits for the various fleet sectors, setting individual vessel catch limits for overfished species (RSCs), and establishing an in-season catch monitoring or verification program to ensure catch caps are not exceeded. This is consistent with Council objectives to prevent overfishing, rebuild overfished stocks, and maintain a year-round fishing season.

Alternative 4 would have a positive and significant impact in reducing the bycatch of overfished species, particularly compared to Alternative 1. In addition to fleet sector caps, individual vessels would also have non-transferable catch limits for overfished species. Coupled with increased monitoring, groundfish bycatch would be significantly reduced compared to Alternative 1 and similar to Alternatives 5 and 6. Alternative 4 would be somewhat less effective than Alternatives 5 and 6 as the latter two options require 100% observer coverage and would apply discard caps for overfished species. In addition, individual vessel catch limits only apply to overfished species in Alternative 4. Incentives to avoid bycatch of emphasis species (important, non-overfished groundfish species) may not be strong enough to eliminate all bycatch of groundfish. This could happen if individual vessel strategies failed to optimize bycatch reduction for the sector.

A portion of some OYs would be held in reserve for vessels observed to have the lowest bycatch of specified species. In order for this opportunity to be viable, monitoring would have to be increased substantially above that required for Alternatives 1, 2 and 3. It is likely vessels wanting access to the reserve would have to provide there own observer coverage when fishing without a NMFS observer.

Impacts of Alternative 4 on Pacific halibut bycatch would likely be similar to Alternative 1, due to continued use of RCAs. Bycatch of Pacific halibut may be slightly reduced due to implementation of individual vessel catch caps and sector catch reserves. While not strictly an IQ program, these tools may provide more flexibility to reduce bycatch and slow the race for fish. Impacts on salmon bycatch would be low and similar to Alternative 1.

Bird interactions with groundfish gears under Alternative 4 are more difficult to predict and would depend on response of fleet sectors to incentives to reduce bycatch of groundfish.

Fishery monitoring would be increased over Alternative 1 at an increased cost.

4.6.5 Summary of Alternative 5 *(Vessel catch quotas, discard caps)*

The policy goal of Alternative 5is to significantly reduce bycatch through individual vessel catch (mortality) quotas. Each vessel would receive transferable restricted species quotas (RSQs) for overfished groundfish species and transferable individual fishing quotas (IFQs) for other groundfish species. A robust monitoring or catch verification program would be implemented to ensure catch caps were not exceeded. Discarding of overfished species would be prohibited (that is, discard caps set at zero for certain species). Certain gear regulations would be rescinded to enable vessels to modify gear and operations to avoid catch of overfished species and reduce unwanted bycatch of all species. A portion of some OYs could be held in reserve for vessels exhibiting low bycatch of specified species.

This alternative is consistent with Council objectives to prevent overfishing, rebuild overfished stocks, and maintain a year-round fishing season.

RSQs and IFQs for individual fishers would have a significant impact in reducing bycatch of both overfished and emphasis groundfish species compared to Alternative 1, and would be similar to Alternative 6. A robust monitoring program and full retention requirement for overfished species would eliminate bycatch of overfished groundfish. Quota transferability would provide more flexibility for fishers to optimize their fishing strategies. Bycatch of emphasis groundfish would be reduced, although some discard might occur under this alternative as fishers approach attainment of the IFQ. Long-term closure areas to bottom fishing would also reduce bycatch within these areas.

Pacific halibut bycatch impacts under Alternative 5 would likely be less than those of Alternative 1. Use of flexible fishing operations and IQs would further reduce the "race for fish" and therefore indirectly reduce bycatch of halibut. Although not expressly considered under this alternative, RSQs, and a small halibut retention cap or reserve could be applied in a fashion similar to groundfish. These tools would likely contribute to additional reductions in halibut bycatch.

Impacts on salmon bycatch would be low and similar to Alternative 1.

Groundfish vessel interactions with seabirds under Alternative 5 would be reduced to the degree the IFQ program results in further fleet reduction. Increased observer coverage would provide improved data on groundfish fleet interactions with seabirds.

Fishery monitoring and monitoring costs would be increased substantially over Alternative 1.

4.6.6 Summary of Alternative 6 *(Marine Reserves, Individual Caps, and Discard Caps)*

The policy goal of Alternative 6 is to reduce bycatch to near zero by establishing marine reserves, using individual vessel catch caps (RSQs and IFQs), prohibiting discard of groundfish, and accurately accounting for catch. This alternative is consistent with Council objectives to prevent overfishing and rebuild overfished stocks.

Alternative 6 would significantly reduce bycatch and bycatch mortality compared to Alternative 1. Impacts of this alternative would be similar to Alternative 5 with additional reductions in bycatch (discard) due to a full retention requirement for many groundfish. Trading and consolidation of RSQ and IFQ shares would be anticipated to further reduce effort and the "race for fish." In addition, marine reserves would permanently remove fishing effort and bycatch from some areas. Alternative 6 would be expected to reduce the bycatch of groundfish and other species more than the other alternatives. Some bycatch and bycatch mortality of groundfish would likely continue in the recreational fishery, however.

Pacific halibut bycatch impacts under Alternative 6 would likely be less than Alternative 1. Use of flexible fishing operations and IFQs would further reduce the "race for fish" and therefore indirectly reduce bycatch of halibut. In addition, marine reserves would also tend to reduce bycatch of Pacific halibut to the degree marine reserves included areas of high halibut concentration.

Impacts on salmon bycatch would be low and similar to Alternative 1.

Seabird interactions with groundfish vessels under Alternative 6 may be reduced to the degree IFQ sales lead to a reduction in fleet size. Bird interactions would also depend on the placement and size of marine reserves. Seabird interactions and mortalities could increase if fishing outside of marine reserves lead to concentration of gear in areas of high seabird abundance. Design of marine reserves could incorporate seabird distribution data to assist in reducing fishery interactions with bird populations. Increased observer coverage under this alternative should improve data on bird interactions with the groundfish fleet.

Fishery monitoring would be extensive compared to Alternative 1 at increased cost.

4.7 Summary of Impacts to the Socioeconomic Environment

Table 4.7.1(a) summarizes the social and economic impacts of Alternatives 1, 2 and 3. Table 4.7.1(b) summarizes the social and economic impacts of Alternatives 4, 5 and 6. The significance of the impacts of all the alternatives is described in Table 4.7.2.

Table 4.7.1(a). Summary of effects of Alternatives 1, 2 and 3 on the social and economic environment (Alternatives 4, 5 and 6 in following table).

	Alternative 1	Alternative 2	Alternative 3
Incentives to Reduce Bycatch	Quota-induced discards can occur when fishers continue to harvest other species when the harvest guideline of a single species is reached and further landings of that species are prohibited. As trip limits become more restrictive and as more species come under trip-limit management, discards are expected to increase. In addition, discretionary discards of unmarketable species or sizes are thought to occur widely. However, in comparison to a "race for fish" allocation system, the current management regime provides harvesters a considerable amount of flexibility to reduce unwanted catch and discards.	Reducing the level of effort in the groundfish fisheries and increasing trip limits would likely reduce the level of groundfish bycatch (discard).	If trip limits increase, the level of groundfish bycatch (discard) would be expected to decline.
Commercial Harvesters	By spreading out fishing more evenly over the year, the current management regime helps maintain traditional fishing patterns. Howver, landings of major target species (other than Pacific whiting) are expected to continue to decline as OYs are reduced to protect overfished species. Declining harvests lead to significant decreases in total groundfish ex-vessel value.	Further fleet reduction would be expected to reduce (but not eliminate) extra capacity in the fishery and to restore the fleet to some minimum level of profitability.	A combination of higher trip limits and a reduction in the length of the fishing season would be expected to lead to an overall reduction in variable fishing costs. With larger trip limits, revenues per trip are expected to increase. However, the overall impact of this alternative on costs and revenues would depend on when individual participants were allowed to fish. For example, fishers may be unable to fish for certain species at optimal times.
Recreational Fishery	Landings of major target species are not expected to increase and may decline further if OYs are reduced to protect overfished species. Decreased harvests lead to significant decreases in recreational value.	Changes in landings of major species targeted in the recreational fishery would be expected to be insignificant.	Effects as described in Alternative 2
Tribal Fishery	Changes in landings of major species targeted in tribal fisheries are expected to be insignificant.	Effects as described in Alternative 1	Effects as described in Alternative 1
Buyers and Processors	The current management regime reduces the likelihood that processing lines will be idle by fostering a regular flow of product to buyers and processors. However, decreased deliveries of groundfish to processors and buyers will result in significant decrease in groundfish product value.	No significant changes in the the total amount of fish delivered to processors is expected. With fewer vessels in the fishery, processors would have fewer boats to schedule for landings. The related reductions in time spent unloading vessels is expected to result in cost savings. However, processors in ports that experience a reduction in fleet size may be negatively affected if they are unable to obtain supplies of fish from alternative sources	Larger trip limits would not be expected to affect the total amount of fish that harvesters deliver to processors. However, with vessels taking longer and potentially fewer trips, processors would have fewer boats to schedule for landings and unloading, reducing their average costs. On the other hand, costs could increase if processors were unable to control the flow of product throughout the year and capital is idle during closed periods.

Table 4.7.1(a). Summary of effects of Alternatives 1, 2 and 3 on the social and economic environment (Alternatives 4, 5 and 6 in following table).

	Alternative 1	Alternative 2	Alternative 3
Communities	By maintaining year-round fishing and processing opportunities, the current management regime promotes year-round employment in communities. However, groundfish employment and labor income are expected to continue to decline, resulting in economic hardship for businesses involved in the groundfish fisheries. These businesses are expected continue to diversify to reduce dependence on groundfish fisheries.	The direction and magnitude of many of the economic effects on particular coastal communities are uncertain, as the distribution of the post-buyback fleet is uncertain. If further reduction in fleet capacity with higher trip limits were successful in increasing net revenues or profits to remaining commercial fishers, positive economic impacts on the communities where those fishers land their fish, home port and reside would be expected. On the other hand, some communities may experience a significant loss of vessels and a consequent decrease in income, jobs and taxes.	The impacts are uncertain, as community patterns of fishery participation vary seasonally based on species availability as well as the regulatory environment and oceanographic and weather conditions. If higher trip limits were successful in increasing net revenues or profits to fishers, positive economic impacts on the communities where those fishers land their fish, home port, and reside would be expected. On the other hand, seasonal closures could leave crew members at least temporarily unemployed.
Consumers	The current management regime allows buyers and processors to provide a continuous flow of fish to fresh fish markets, thereby benefitting consumers. Consumers of fresh or live groundfish may be adversely affected by reduced commercial landings. However, changes in benefits to most consumers of groundfish products would be expected to be insignificant due to availability of substitute products.	Effects as described in Alternative 1	Consumers of fresh or live groundfish could be unable to obtain fish from the same sources for half of the year unless the harvest sectors are split into two groups, with one group of vessels active at any given time.
Fishing Vessel Safety	Some gains in fishing vessel safety are at least partially realized under the current management regime, as fishers are able to fish at a more leisurely pace and avoid fishing in dangerous weather or locations. However, safety of human life at sea may decrease if reduced profits induce vessel owners to forgo maintenance, take higher risks or hire inexperienced crews.	Increases in net revenue to harvesters resulting from increases in trip limits may enhance their ability to take fewer risks and use their best judgment in times of uncertainty, thereby increasing vessel safety.	The effects on vessel safety may be mixed. Increases in net revenue to harvesters resulting from increases in trip limits may lead to reductions in injury and loss of life because of harvester's enhanced ability to take fewer risks and use their best judgment in times of uncertainty. However, set seasons make it more difficult for harvesters to make wise decisions as to when and where to fish.
Management and Enforcement Costs	The management regime is expected to continue to be contentious, difficult and expensive. Technological developments such as VMS may mitigate the rate at which management costs escalate.	Costs are expected to decrease, as fewer vessels are generally easier and less expensive to monitor.	Effects will vary depending on the way the seasonal closure is structured. Costs are expected to decline if there is no fishing activity to monitor for 6 months of the year. However, there will be increased costs if permit holders are divided into groups.

Table 4.7.1(b). Summary of effects of Alternatives 4, 5 and 6 on the social and economic environment. (Alternatives 1, 2 and 3 in preceding table).

	Alternative 4	Alternative 5	Alternative 6
Incentives to Reduce Bycatch	While it would be in the best interest of all vessels within a sector to reduce the catch of overfished species, a "race for fish" could develop in which individual vessels eschew fishing practices that reduce bycatch in order to attain their landing limits as quickly as possible. Setting individual catch limits would prevent that. In addition, if cooperative patterns of behavior emerge, decreases in bycatch would be expected.	The amount of fish discarded by each vessel would be counted against the vessel's limit. This measure provides strong economic incentives to reduce the catch of unwanted fish because it "internalizes" the costs of discarding fish.	Marine reserves would prohibit fishers from fishing in certain areas in order to reduce the probability that fish will be caught and discarded, while the 100% retention requirement would be the primary means of reducing groundfish bycatch (discard) outside of marine reserves. Prohibiting discard would produce a strong incentive to avoid unwanted catch because the costs of sorting, storing, transporting and disposing of fish that cannot be sold may be substantial. If vessel groundfish quotas are transferable, Alternative 6 would be similar to Alternative 5; if not transferable, negative effects would be much more significant and more similar to Alternative 4.
Commercial Harvesters	A reduction in harvest and exvessel revenues could result from early attainment of overfished species sector caps. However, the total amount of fish available for retained harvest would be expected to increase, as vessels would increase retention of groundfish, and the level of bycatch would be measured more accurately through expanded observer coverage. The economic benefit of increased landings must be weighed against the additional operating costs that vessel owners would incur from the expanded observer coverage. The allocation of catch limits to individual sectors could lead to economic benefits if private agreements allocating transferable harvesting privileges were negotiated.	Current vessel owners as a group would likely benefit from a system that allocates freely transferable and leaseable quota shares to vessel owners on the basis of catch histories. Moreover, the total amount of fish available for harvest would increase, as bycatch would be measured more accurately through expanded observer coverage. Not all vessel owners would benefit equally, and the relative benefits would depend on the allocation formula. In addition, the economic benefits must be weighed against the additional operating costs that vessel owners would incur from the expanded observer coverage.	Some measures would significantly increase fishing costs, while other would reduce them. For example, 100% groundfish retention, full observer coverage, and establishment of marine reserves would increase average costs, whereas the establishment of ITQs for groundfish species would reduce costs.
Recreational Fishery	This alternative may have a negative economic effect on recreational fishers if its sector catch limit were exceeded. The ability to detect excessive catches within the recreational sector would be enhanced by a CPFV observer program and expanded port/field sampling. The ability of the recreational sector to avoid a fishery closure by controlling catch of overfished species through an incentive program is likely to be limited, as there are many and diverse participants. Dividing the recreational sector into geographical (e.g., state-based) subsectors could mitigate some of the negative effects.	The creation of tradable quota shares for the commercial fishing/processing sectors is not expected to apply to the recreational fishery. The possibility of creating ITQs for recreational fishers may exist, but any discussion of how such a allocation would be achieved or its effects on recreational fishers would be speculative.	Rights-based system effects would be as described in Alternative 5. Marine reserves could benefit recreational fishers over the long term if local catch rates and fish size increased due to spillage of adults out of the marine reserves. On the other hand, if marine reserves resulted in geographic redistribution of the commercial and recreational fleets, the concentration of fishing effort in the areas that remain open could lead to localized stock depletion, reduced recreational catch per unit effort, and reduction in the quality of the fishing experience.
Tribal	Changes in landings of major species targeted in tribal fisheries are expected to be insignificant.	Effects as described in Alternative 1	Effects as described in Alternative 1

Table 4.7.1(b). Summary of effects of Alternatives 4, 5 and 6 on the social and economic environment. (Alternatives 1, 2 and 3 in preceding table).

	Alternative 4	Alternative 5	Alternative 6
Fishery			
Buyers and Processors	The economic effects on buyers and processing companies are uncertain because of the uncertainty as to how well vessel owners within sectors can successfully manage bycatch. To the extent that commercial harvesters adopt bycatch-reducing fishing tactics, processors and buyers would be expected to benefit from higher catches. On the other hand, if an entire fishing sector is shutdown, buyers and processors may experience significant shortages of fish.	Buyers and processors would be expected to benefit from the anticipated increases in fish landings. The overall level of benefits and the distribution of benefits across processors may depend largely on the formula for allocating quota shares. Arguments have been made that harvester-only ITQ programs may result in stranded capital in the processing sector and a shift in the balance of bargaining power toward harvesters. These potential adverse effects could be mitigated if processors were also allocated quota shares.	The net economic effect on buyers and processors is uncertain. In general, buyers and processors would be expected to benefit from the anticipated increases in fish landings that result from the implementation of a rights-based system. The 100% retention requirement could also result in a large increase in landings. However, it is uncertain how much of the additional fish retained would be marketable. Because of their lack of mobility, buyers and processors may be especially negatively affected by marine reserves. However, the effects of marine reserves on specific buyers and processing companies will depend in part on changes in local supply and how processors have adapted to current supply situations.
Communities	To the extent that harvesting sectors are not shut down, no significant economic impact on communities is likely. However, if sector closures occurred, there would likely be negative impacts in fishing communities, particularly if processing plants were also closed.	Consolidation of fishing and processing activities to fewer vessels and plants would likely result in reductions in the numbers of crew members and processing workers employed. Granting quota shares to community groups could help maintain existing harvesting and processing patterns and serve to meet concerns about employment in communities.	Effects of a right-based management system as described in Alternative 5. Marine reserves would be expected to help ensure harvests for future generations and the sustained participation of communities in groundfish fisheries. If, however, marine reserves resulted in substantial decreases in groundfish catches over the short term, the economic hardships that fishing families and other members of communities are experiencing under Alternative 1 (no action) would be exacerbated.
Consumers	If no early closures of major harvesting sectors occur, the impact on consumers would be expected to be negligible. However, if major fishing sectors were shut down, consumers of fresh or live groundfish could be adversely affected.	Consumers would be expected to benefit from the anticipated increases in fish landings. There is some chance that consumers could be negatively affected, if a rights-based system leads to a decrease in the overall competitiveness of markets for certain groundfish products (e.g., live fish). The likelihood of this occurring would depend both on the level of consolidation that might occur and the elasticity of demand for particular products.	Consumers would benefit from the anticipated increased landings that result from a rights-based system. In addition, over the long term, marine reserves that effectively increase the size and variety of seafood species could make consumers better off. On the other hand, large marine reserves could substantially decrease seafood supply enough to make consumers worse off, at least in the short term. Marine reserves could have a positive effect on those consumers who derive non-consumptive benefits from marine ecosystems, including non-market benefits (e.g., existence value).
Fishing Vessel Safety	The effects on vessel safety are uncertain. Possible increases in the profitability of harvesting operations could lead to reductions in injury and loss of life because of harvesters' enhanced ability to maintain equipment, take fewer risks and use their best judgment in times of uncertainty. Without individual vessel catch limits, if an intense "race for	Possible increases in the profitability of harvesting operations would likely lead to reductions in injury and loss of life because of harvesters' enhanced ability to maintain equipment, take fewer risks and use their best judgment in times of uncertainty.	The net effect of the various measures included in this alternative on fishing vessel safety is uncertain. The establishment of ITQs for groundfish species is expected to promote vessel safety by reducing the pressure to fish under dangerous conditions. On the other hand, the establishment of marine reserves may result in a reduction in fishing vessel safety if the

Table 4.7.1(b). Summary of effects of Alternatives 4, 5 and 6 on the social and economic environment. (Alternatives 1, 2 and 3 in preceding table).

	Alternative 4	Alternative 5	Alternative 6
	fish" could develop. The increased competition among fishers would likely increase the risks they would be willing take to harvest fish.		closure of fishing grounds results in vessels fishing farther from port and possibly in more hazardous areas.
Management and Enforcement Costs	Costs would be expected to increase as catch limits were allocated over an increasing number of sectors. It would be necessary to obtain precise and reliable estimates of the quantities of target and non-target catches within each sector. An expanded port/field sampling program to improve estimates of recreational catch would entail a larger budget for the state and federal agencies currently involved in data collection.	The costs of monitoring, enforcement and administration would be expected to increase significantly. Cost recovery measures such as a fee on quota holders would be expected.	Full (100%) observer coverage would be required, which would facilitate enforcement of a full retention regulation. The enforcement costs of establishing marine reserves vary with several factors, including the location, number, size, and shape of the marine reserves and types of activities restricted and allowed.

Table 4.7.2. Significance of indirect effects on the social and economic environment.

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Incentives to Reduce Bycatch	S+/S-	S+	S+	CS+	CS+	S+
Commercial Harvesters	S-	S+	CS+	CS+/CS-	S+/S-	S+/S-
Recreational Fishery	S-	I	I	CS-	CS-	S+/S-
Tribal Fishery	I	I	I	CS-	CS-	CS-
Buyers and Processors	S-	CS+/CS-	CS+/CS-	CS+/CS-	CS+	CS+/CS-
Communities	S-	CS+/CS-	CS+/CS-	CS-	CS+	CS+/CS-
Consumers	I	I	CS-	CS-	CS+	CS+/CS-
Fishing Vessel Safety	CS+/CS-	S+	S+/S-	CS-	S+	S+/S-
Management and Enforcement Costs	S-	S+	CS+/CS-	S-	S-	S-

Significance Ratings:

Significantly Adverse (**S-**): Significant adverse impact based on ample information and the professional judgment of the analysts.

Significantly Beneficial (**S+**): Significant beneficial impact based on ample information and the professional judgment of the analysts.

Conditionally Significant Beneficial (**CS+**)/Conditionally Significant Adverse (**CS-**): Conditionally significant is assigned when there is some information that significant impacts could occur, but the intensity of the impacts and the probability of occurrence are unknown.

Insignificant Impact (**I**): No significant change based on information and the professional judgment of the analysts..

Unknown (**U**): This determination is characterized by the absence of information sufficient to adequately assess the significance of the impacts.

Significantly Beneficial/Significantly Adverse (**S+/S-**): Both significant adverse impacts and significant beneficial impacts are expected to occur. The net effect may be uncertain.

4.8 Cumulative Effects of the Alternatives

Cumulative effects must be considered when evaluating the alternatives to the issues considered in this EIS. Cumulative impacts are those combined effects on quality of human environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what federal or non-federal agency undertake such actions (40 CFR 1508.7, 1508.25(a), and 1508.25 (c)).

The area that would be affected by actions in this document is the Pacific Coast Groundfish Fishery in the EEZ (3 to 200 miles off shore).

Cumulative effects are the total effect, or combination of direct and indirect impacts, with external factors affecting components of the human environment. Direct effects include potential reductions of bycatch and bycatch mortality. Increased accountability and improved information about stock removals and stock condition are other effects. Indirect effects are related to longer term changes such as changes in species abundance and diversity. Species habitat can be affected both directly and indirectly by fishing activities. External factors dominating the Pacific Coast groundfish fishery[1] include meso-scale climate events and climate changes such as the El Nino and La Nina events, coupled with longer term Pacific Decadal Oscillation regime shifts. These factors drive much of the productivity of resources within the management area. Factors related to ecosystem structure also may influence cumulative effects. For example, past fishing activities (both for groundfish and other marine fishes) have altered species composition and abundance of many species. This is most apparent with respect to the nine overfished groundfish species. Rebuilding plans and bycatch alternatives that seek to conserve and restore these rockfish to their former abundance will have significant beneficial impacts on these and other marine animals. However, because marine food webs have multiple competitors in each trophic level, some species may be unsuccessful in regaining their previous dominance, especially if their niche has been colonized by a productive and successful competitor.

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[1]These have been described in the 2003 Groundfish Annual Specifications EIS (PFMC, 2003e), which is incorporated by reference.

Cumulative effects are the aggregate of past, present, and reasonable foreseeable actions. Of the past, proposed and foreseeable future actions that are also expected to affect these same waters and fishers, the most notable recent actions were the annual specifications and management measures for the groundfish fisheries in 2003 and 2004, the passage of a major rebuilding plan for overfished stocks of groundfish (FMP Amendment 16-2), and completion of the trawl buyback program. In 2003, the Pacific Council recommended and NMFS implemented broad time/area closures for fishing across much of the continental shelf. These were intended to further the conservation goals and objectives of the FMP by allowing fishing to continue in areas and with gears that can harvest healthy stocks with little coincidental catch of low abundance species. The effects of the 2003 and 2004 groundfish specifications and management measures, including cumulative impacts, have been described and analyzed in final EISs prepared by the Pacific Council. These EISs provide a discussion of several mitigating factors that emerged during the development of the depth-based management regime adopted for the 2003 and 2004 fisheries.

The permit buyback program for the groundfish trawl fleet was implemented in late 2003. This program has significantly reduced the number of limited entry trawl vessels. Effort reduction could reduce the impacts of fishing in the long run. However, the trip limit management program has prevented many commercial fishing vessels from operating near their harvest capacity. Even with a smaller fleet, restrictions will be necessary to prevent vessels from increasing their efficiency and "fishing power." Bycatch mitigation tools such as individual fishing quotas can exert a powerful influence on harvest capacity by changing the basic incentive structure of the industry. Over time, such rights-based programs can substantially reduce effort levels and better respond to natural population fluctuations.

Finally, VMS was implemented in January of 2004. This vessel tracking system will significantly improve catch accountability. VMS alternatives and cumulative impacts are described in the EA/RIR for A Program to Monitor Time-Area Closures in the Pacific Coast Groundfish Fishery (PFMC, 2003e).

Alternatives considered in this draft EIS incorporate many bycatch mitigation tools and other measures currently used to manage the groundfish fishery. Depth-based and marine protected areas, coupled with effort reduction, are among the mitigation tools that reduce bycatch and bycatch mortality. Measures that increase accountability and recording of all catch will also help mitigate the effects of bycatch.

Tables 4.8(a) and 4.8(b) summarize cumulative effects of the proposed action and alternatives.

4.8.1 Cumulative Effects on the Marine Ecosystem, Habitat, and Biodiversity

When combined with the external factors identified above, most of the alternatives are likely to have modest but probably indistinguishable effects on the marine ecosystem, habitat, and biodiversity. Alternative 6 would establish long-term no-take marine reserves which would be closed to most or all fishing. Elimination of such human disturbances may result in both anticipated and unexpected changes to the ecosystem: certain habitats would be expected to return to a more natural state, and biodiversity would likely increase within these areas. The degree of change would be expected to be proportional to the size of the closed areas. The greatest effects would be expected with stationary and relatively immobile benthic species that would typically flourish in the habitats protected by such reserves.

4.8.2 Cumulative Effects on Groundfish

As was noted in the 2003 Groundfish Annual Specifications EIS (PFMC, 2003b), overfished stock status is a cumulative effect, since it results from past overfishing that reduced the stock size. Under Alternative 1, management measures including those used to address bycatch issues would result in a significant adverse cumulative effect on bocaccio and canary rockfish; catches may remain unsustainably high under the no action alternative. Likewise, Alternative 3 would have the potential for significant adverse cumulative effects if reduced fishing time did not result in larger trip limits; bycatch would not to be reduced in that circumstance.

Alternatives 4, 5 and 6 complement rebuilding efforts by accounting for and reducing bycatch and bycatch mortality. They would accomplish this through catch caps and increased monitoring. Cumulative adverse effects of fishing and bycatch would tend to diminish for overfished and healthy stocks of groundfish in proportion to effort reduction and protection afforded by these alternatives, especially Alternatives 5 and 6). For bocaccio, there still may be a significant cumulative adverse effect across all alternatives. Modeling of this stock's rebuilding potential indicates rebuilding may not occur even if very conservative management measures are imposed. Changes in ocean conditions could improve or reduce the chances of stock recovery.

Under Alternative 6 and perhaps Alternative 5, long-term protected areas may result in increased species diversity and an increase in average size of groundfish within the protected areas.

4.8.3 Cumulative Effects on Protected Species

Cumulative effects generally correlate with direct and indirect effects and external environmental factors. Alternatives that result in reduced fishing effort would result in smaller adverse cumulative effects on halibut, salmon, seabirds, and marine mammals (Alternatives 2, 5, and 6). These effects would likely be insignificant across all alternatives, as impacts are considered low under the no action Alternative 1. Cumulative impacts of Alternative 3 are more difficult to predict, as the timing of seasonal openings and closures may influence interactions with protected species.

4.8.4 Cumulative Effects on Groundfish Fisheries

Alternative 1 is likely to have a significant adverse cumulative effect. Efforts to rebuild bocaccio and canary rockfish may not be successful under the no action alternative. Additional restrictive management measures may result in reduced future harvest opportunities for healthy stocks or a concentration of effort outside of closed areas or within shorter time periods. Discard/bycatch rates may increase as a result of increase competition during open periods and areas. Accountability would be lower than other alternatives, resulting in greater uncertainty. The cumulative effects of increased regulation, lower fishery yields, uncertainty, and disruption of fishing patterns would be anticipated to be adverse and significant. Alternative 3 has the potential to create a race for fish due to a shortened season. Thus, Alternative 3 may also result in adverse cumulative effects on the fishery if shortening the season failed to increase trip limits or reduce bycatch.

Alternatives 2, 4, 5 and 6 should have positive (beneficial) incremental effects when combined with other management alternatives supportive of rebuilding overfished stocks. Alternatives 4, 5 and 6 should have substantial or significant cumulative effects in reducing bycatch, bycatch mortality, and increasing accountability. These effects are likely to have a long-term beneficial effect if stocks return to levels capable of producing higher sustainable harvests. Trawl fleet capacity would be reduced under Alternative 2; even greater consolidation would be expected under Alternatives 5 and 6. Under Alternative 2, latent effort potentially could lead to increased harvest rates in spite of fleet reduction. Additional restrictive management measures may still be required to maintain rebuilding. Alternatives 5 and 6 have the greatest potential to reduce latent capacity. Over the long-run, this could mean a positive cumulative fishery effect resulting in reductions in latent effort, healthier stocks, and a reduced need for additional restrictive management measures.

4.8.5 Cumulative Effects on Safety

VMS systems used to increase accountability should make fishing vessels inherently easier to locate and therefore safer if the vessel and crew are in jeopardy. Various kinds of area closures used in the all of the alternatives may cause vessels to fish further off shore and may increase risk. There may be a significant positive cumulative benefit and increased fleet safety for those alternatives that reduce effort (Alternatives 2, 5, and 6) or establish transferable catch quotas (Alternatives 5 and 6) as these bycatch reduction tools would tend to reduce the race for fish.

Table 4.8(a). Summary of direct, indirect and cumulative effects of Alternatives 1, 2 and 3.

Resource Issue or Category	Alternative 1	Alternative 2	Alternative 3
Habitat: Trawl and other gear contacting the bottom damage benthic organisms and physical structure			
Direct/Indirect	No change from baseline	No change from baseline	No change from baseline
Cumulative	No change from baseline	No change from baseline	No change from baseline
Ecosystem/Biodiversity: Lowered abundance of particular species changes ecosystem structure, stock declines lead to local/regional extinction.			
Direct/Indirect	No change from baseline	No change from baseline	No change from baseline
Cumulative	No change from baseline	No change from baseline	No change from baseline
Groundfish: Bycatch and bycatch mortality of overfished and other groundfish			
Direct/Indirect	Catch rates of overfished species such as canary and bocaccio rockfish may delay or prevent rebuilding. Discard/bycatch of other groundfish could remain high due to constraints for overfished species.	Reduced fishing effort expected to reduce bycatch and bycatch mortality of overfished and other groundfish. Latent capacity remains and could negate any savings.	Effects may be similar to Alternative 1 if shortened season does not result in larger trip limits.
Cumulative	Canary and bocaccio rockfish may not be sustainable.	Higher probability of rebuilding overfished species. Reduced bycatch and bycatch mortality of other groundfish may allow fuller resource utilization but not necessarily increased abundance.	Effects may be similar to Alternative 1 if shortened season does not result in larger trip limits.
Protected species: Bycatch and bycatch mortality of Pacific halibut, Pacific salmon, marine birds and mammals.			
Direct/Indirect	No change from baseline	No change from baseline	Interactions are thought to be low, but may be completely absent during seasonal closures. Halibut bycatch depends on timing of seasonal closures.
Cumulative	No change from baseline	No change from baseline	Interactions with birds depend on timing of seasonal closures.
Accountability: Increased monitoring bycatch and bycatch mortality improves accountability.			
Direct/Indirect	Provides for statistically reliable measures of bycatch on an annual basis, but not inseason.	Marginal improvement in monitoring coverage of trips.	Marginal improvement in monitoring coverage of trips
Cumulative	Lack of timely inseason data may lead to unsustainable fisheries for some overfished species.	Similar to Alternative 1 - data cannot be used in-season.	Similar to Alternative 1 - data cannot be used in-season

Table 4.8(b). Summary of effects of Alternatives 4, 5, and 6 for West Coast groundfish fisheries.

Resource Issue or Category	Alternative 4	Alternative 5	Alternative 6
Habitat: Trawl and other gear contacting the bottom damage benthic organisms and physical structure			
Direct/Indirect	No change from baseline	Reduction in closed areas	Reduction in closed areas
Cumulative	No change from baseline	Increased growth of living benthic habitat (sponges and corals) in closed areas.	Increased growth of living benthic habitat (sponges and corals) in closed areas.
Ecosystem/Biodiversity: Lowered abundance of particular species changes ecosystem structure, stock declines lead to local/regional extinction.			
Direct/Indirect	No change from baseline	Increased growth and abundance of some species in closed areas	Increased growth and abundance of some species in closed areas
Cumulative	No change from baseline	Increased biodiversity in closed areas	Increased biodiversity in closed areas
Groundfish: Bycatch and bycatch mortality of overfished and other groundfish			
Direct/Indirect	Reduces bycatch and bycatch mortality of overfished species in particular - due to RSQ caps for overfished species.	Reduces bycatch and bycatch mortality of overfished and other groundfish through use of MPAs, RSQs and IFQs for overfished and other groundfish.	Reduces bycatch and bycatch mortality of all groundfish through use of no-take reserves, RSQs, IFQs, and 100% groundfish retention requirement.
Cumulative	Higher likelihood and rate of rebuilding, with possible exception of bocaccio rockfish.	Higher likelihood and rate of rebuilding of overfished groundfish, possible increases in other groundfish populations.	Highest likelihood and rate of rebuilding of overfished groundfish. Increased size and diversity of groundfish within closed areas.
Protected species: Bycatch and bycatch mortality of Pacific halibut, Pacific salmon, marine birds and mammals.			
Direct/Indirect	No change from baseline.	Small reductions in bycatch and bycatch morality within protected areas.	Small reductions in bycatch and bycatch morality within protected areas.
Cumulative	No change from baseline.	No change from baseline.	No change from baseline.
Accountability: Increased monitoring bycatch and bycatch mortality improves accountability.			
Direct/Indirect	Significantly improved monitoring coverage. In-season data can be used to make in-season adjustments. Accurate in-season accounting of overfished stocks of groundfish.	Significantly improved monitoring coverage with 100% observer coverage of commercial fleet. Real-time accounting of groundfish. Discard/ bycatch of overfished groundfish nearly eliminated.	Significantly improved monitoring coverage with 100% observer coverage of commercial fleet. Real-time accounting of all groundfish catch. No groundfish discard/bycatch.
Cumulative	Reduced risk and higher likelihood of rebuilding overfished stocks of groundfish.	Reduced risk and higher likelihood of rebuilding overfished groundfish stocks.	Reduced risk and higher likelihood of rebuilding overfished groundfish stocks.

5.0 CONSISTENCY WITH THE GROUNDFISH FMP AND MAGNUSON-STEVENS ACT NATIONAL STANDARDS

Goal 1: Conservation. Prevent overfishing, to the extent practicable, and rebuild overfished stocks by managing for appropriate harvest levels and prevent any net loss of the habitat of living marine resources.

5.0 Consistency with the Groundfish FMP and Magnuson-Stevens Act National Standards

5.1 Consistency with the Groundfish FMP

The groundfish FMP goals and objectives are listed below. The way in which the alternatives address each objective is briefly described.

Objective 1. Maintain an information flow on the status of the fishery and the fishery resource which allows for informed management decisions as the fishery occurs.

Alternative 1 (status quo/no action) employs the same data sources that have been used in past years to monitor groundfish fisheries. In addition, data from the first year of the NMFS observer program (August 2001 to August 2002) became available in early 2003 and were used for inseason management. In particular, more accurate data to determine bycatch rates for overfished species have been derived from these data and applied to develop management measures for 2004. A vessel monitoring system for the limited entry fishery went into effect January 1, 2004, providing real-time location information on participating vessels. These information sources would also apply to Alternatives 2 and 3 evaluated in this EIS. Alternative 4 would modify observer coverage so that all sectors would be monitored throughout the year, and a higher percentage of commercial vessels would be monitored. In addition, observer reporting and application would be accelerated to make data available for inseason management. Alternatives 5 and 6 would expand the monitoring program so that all limited entry vessels would be monitored whenever fishing for groundfish, and perhaps at other times as well (for example, if fishing for pink shrimp). A program to monitor the transfer of individual quotas would also be required.

Objective 2. Adopt harvest specifications and management measures consistent with resource stewardship responsibilities for each groundfish species or species group.

None of the alternatives would modify the current procedures for determining harvest specifications. Alternatives 1, 2 and 3 would emphasize traditional management measures to mitigate bycatch. Alternative 4 establishes overfished species catch/ mortality limits for individual vessels and thus increases vessel accountability. By establishing catch/mortality limits for sectors of the fishery, Alternative 4 increases the level of accountability for each sector as well. However, this alternative provides less flexibility to vessels that encounter an unexpected number of overfished species and are required to stop fishing for the remainder of the fishing period. Alternative 5 allows vessels to obtain additional quota (by purchase, barter, etc.) so they may continue fishing for other species. Alternative 5 also raises the possibility that other management restrictions might be relaxed because those restrictions might prove to be redundant and unnecessary.

Objective 3. For species or species groups that are overfished, develop a plan to rebuild the stock as required by the Magnuson-Stevens Act .

All of the alternatives would maintain the policy of risk averse harvest levels for overfished species.

Objective 4. Where conservation problems have been identified for nongroundfish species, and the best scientific information shows the groundfish fishery has a direct impact on the ability of that species to maintain its long-term reproductive health, the Council may consider establishing management measures to control the impacts of groundfish fishing on those species. Management measures may be imposed on the groundfish fishery to reduce fishing mortality of a nongroundfish species for documented conservation reasons. The action will be designed to minimize disruption of the groundfish fishery, in so far as consistent with the goal to minimize the bycatch of nongroundfish species, and will not preclude achievement of a quota, harvest guideline, or allocation of groundfish, if any, unless such action is required by other applicable law.

This objective may be inconsistent with the Sustainable Fisheries Act mandate to reduce bycatch to the extent practicable. The objective was intended to limit restrictions on groundfish fishing that would primarily be intended to make more halibut and non-ESA salmon available to directed fisheries for those species. That is, the Council did not want to restrict groundfish fishing for non-groundfish allocation reasons. However, non-groundfish species include turtles, corals, sponges and many other species of fish that may be affected by groundfish fishing activities.

Alternatives 1-5 specifically address bycatch of groundfish species and collection of information about bycatch of other species. Alternative 6 would establish a higher priority to mitigate bycatch of non-groundfish species through no-take marine reserves and restriction of on-bottom fishing gears.

Objective 5. Describe and identify EFH, adverse impacts on EFH, and other actions to conserve and enhance EFH, and adopt management measures that minimize, to the extent practicable, adverse impacts from fishing on EFH.

The use of MPAs (RCAs/GCAs) under all alternatives will reduce EFH impacts to by eliminating many fishing-related impacts in those areas. Alternative 5 could reduce reliance on area management of groundfish fishing activities, while Alternative 6 would establish no-take reserves that would reduce all fishing-related impacts within whatever boundaries might be established. Redistribution of effort into open areas could intensify fishing effort in some areas under all the alternatives, resulting habitat impacts that cannot be predicted at this time. Alternatives 5 and 6 would likely result in fewer vessels as an effect of rights-based management. In addition to the MPAs (RCAs/GCAs) included in Alternatives 1-5, bottom trawlers are currently required to use small footropes shoreward of GCAs. This tends to lessen impacts in rocky areas of the continental shelf, which is preferred habitat for some overfished groundfish species.

Goal 2: Economics. Maximize the value of the groundfish resource as a whole.

Objective 6. Attempt to achieve the greatest possible net economic benefit to the nation from the managed fisheries.

Calculating net costs and benefits in 2003 (including the imputed value of non-market costs and benefits) and the present value of all future net benefits would be the best way to measure net benefit. Because of the programmatic nature of this EIS, no quantitative analysis is attempted. However, the elements of such an analysis are identified and described in Chapter 4. Due to the overfished status of several groundfish stocks, and reduced abundance of others, the net economic benefit from the groundfish fisheries will remain far below the gross value for the foreseeable future. There is no directly comparable measure of the conservation benefits of the alternatives (such as net present value of future harvests), so it is not possible to determine if any of the other alternatives would achieve the greatest possible net economic benefit. Furthermore, future best use of resources (in terms of economic return), which would predicate future allocation decisions, cannot be predicted. However, all the program alternatives fall within a management framework intended to achieve maximum sustained yield over the long term. This gives greater latitude for future decision making to achieve maximum economic net benefit. Although net present value of future benefits cannot be measured, the Alternatives 1, 2 and 3 would appear most likely to result in higher short term revenues than Alternatives 4 and 6. By establishing a rights-based management program and potentially relaxing redundant management measures, Alternative 5 would be expected to be the most likely to increase net benefits most quickly. Although Alternative 6 would also establish a rights-based management program, application of no-take marine reserves would tend to reduce the potential economic efficiency gains for an extended period. That could be compensated in the longer term by increased biological productivity and/or production that results from eliminating human interference within the reserves.

Objective 7. Identify those sectors of the groundfish fishery for which it is beneficial to promote year-round marketing opportunities and establish management policies that extend those sectors' fishing and marketing opportunities as long as practicable during the fishing year.

None of the alternatives explicitly identifies particular sectors for which a year-round fishery may be beneficial. Alternatives 1 and 2 simply maintain the current year-round fishery for all sectors, using 2-month cumulative limits. Alternatives 3 and 4 could be managed to distribute sector-by-sector effort across the year. However, Alternatives 5 and 6 specifically allow the market to determine the distribution groundfish deliveries over the year and thus may come closest to achieving this objective.

Alternatives 1, 2, 4, 5 and 6 would maintain the priority for year-round commercial fisheries, bearing in mind that individual fisheries, such as the directed fixed gear sablefish fishery, are seasonally constrained. Given low harvest specifications for some overfished species, however, actual harvests may result in early attainment of a particular specification, necessitating the closure of particular fisheries. Alternative 2, by reducing effort, would be expected to improve the likelihood of year round fishing. Alternative 3 specifically reduces the priority of that objective. Alternative 5, by replacing seasonal constraints with market-based opportunities, would be expected to promote year-round fishing.

Objective 8. Gear restrictions to minimize the necessity for other management measures will be used whenever practicable.

> Alternatives 1, 2, 3, 4 and 6 would continue the reliance on gear restrictions to minimize bycatch to the extent practicable. Alternatives 1, 2 and 3 would rely on gear restrictions in combination with trip limits, Alternative 4 in combination with both retention and catch limits, and Alternative 6 in combination with vessel catch limits. Alternative 5 would relax reliance on gear restrictions and provide incentives for vessels to adopt their own best practices to reduce bycatch, including using different gear configurations and types. Under all the alternatives, a portion of the OY for certain species could be allocated to vessels fishing under exempted fishing permits (EFPs). Some of these EFPs are being used as a means to test new gear configurations that reduce bycatch of overfished species. Under Alternative 4, portion of the OY for certain species could be made available to vessels and sectors with low bycatch rates as additional incentive to reduce bycatch.

Goal 3: Utilization. Achieve the maximum biological yield of the overall groundfish fishery, promote year-round availability of quality seafood to the consumer, and promote recreational fishing opportunities.

Objective 9. Develop management measures and policies that foster and encourage full utilization (harvesting and processing) of the Pacific Coast groundfish resources by domestic fisheries.

> There has been no foreign fishing on the West Coast for more than a decade, so all of the alternatives meet this objective.

Objective 10. Recognizing the multispecies nature of the fishery and establish a concept of managing by species and gear or by groups of interrelated species.

> Bycatch mitigation tools under each programmatic alternative would address species groups and relationships in time and space. Alternative 5 would establish a program where individual fishers would be responsible for self-managing their activities to achieve their harvest goals, rather than the Council and NMFS dictating how it should be done. Alternative 6 could be interpreted as expanding management of the groundfish fishery to take into account

non groundfish species as well. The focus on establishment of MPAs would be intended to address broader ecosystem issues and to reduce deleterious impacts on a broader spectrum of marine life.

Objective 11. Strive to reduce the economic incentives and regulatory measures that lead to wastage of fish. Also, develop management measures that minimize bycatch to the extent practicable and, to the extent that bycatch cannot be avoided, minimize the mortality of such bycatch. In addition, promote and support monitoring programs to improve estimates of total fishing-related mortality and bycatch, as well as those to improve other information necessary to determine the extent to which it is practicable to reduce bycatch and bycatch mortality.

Alternatives 1, 2 and 3 continue the reliance on trip limits to control bycatch and bycatch mortality. However, trip limits rely on regulatory bycatch (discard) and may contribute to economic discard as well. Alternatives 2 and 3 are intended to increase the size of trip limits, which would be expected to reduce regulatory bycatch. Catch limits, as proposed in Alternatives 4, 5 and 6, provide much stronger incentives to avoid unwanted fish and to increase the utilization of all fish that are caught. Alternative 5 would establish a rights-based management program to mitigate bycatch, removing many of the economic incentives (and requirements) to discard. The expected result would be that vessels would have greater incentive to avoid unwanted fish and also to increase their use of all fish they catch.

Objective 12. Provide for foreign participation in the fishery, consistent with the other goals to take that portion of the OY not utilized by domestic fisheries while minimizing conflict with domestic fisheries.

This objective is no longer relevant, since all stocks are fully utilized by domestic fishers.

Social Factors.

Objective 13. When conservation actions are necessary to protect a stock or stock assemblage, attempt to develop management measures that will affect users equitably.

Alternative 5 would establish a market-driven quota program. The Council and NMFS role would be to determine the initial allocation of fishing privileges and establish the rules and process for the market to operate.

Thereafter, the market would largely determine what is equitable. Alternatives 1, 2, 3 and 4 would continue reliance on the Council public process for determining equatability on a case-by-case basis. Alternative 6 would likely be some combination of the two approaches.

Objective 14. Minimize gear conflicts among resource users.

This objective initially referred to conflicts between fixed-gear and trawl gear use of certain fishing grounds, it has also been more broadly applied to other conflicts. Alternative 4 would establish vessel and sector catch limits. In the short term, this would increase allocation debates and conflicts until those catch limits were established. Once established, sector caps would insulate each sector from competitive pressures from other sectors. This would tend to reduce the "race for fish" and reduce disincentives to take actions to reduce bycatch, further reducing conflicts among users. Similar to Alternative 4, Alternatives 5 and 6 would require initial catch allocation between user groups that would likely be controversial. Alternatives 5 and 6 would establish a market system which would provide a means for users to resolve conflicts over the longer term.

Objective 15. When considering alternative management measures to resolve an issue, choose the measure that best accomplishes the change with the least disruption of current domestic fishing practices, marketing procedures, and the environment.

Alternatives 1 and 3 are the most similar to current fishing conditions, but also do the least to improve the current situation. Alternative 2, by further reducing the number of trawl participants, would improve conditions for those remaining in the fishery. Alternative 4 would establish equal catch limits for all vessels within a sector and could be refined to rely strictly on sector caps for fully-monitored sectors. Alternative 5, by establishing an IQ program, would be expected to provide the best long term opportunities for the industry as a whole. However, it is likely an IQ program would result in further consolidation of the commercial fleet, likely by reducing the number of small or inefficient vessel.

Objective 16. Avoid unnecessary adverse impacts on small entities.

Adverse impacts on small entities continue to occur under *status quo* management and are unavoidable in the short term. Alternatives 2 and 3 are most similar to the current bycatch mitigation and management programs and will thus have the least effect (both beneficial and adverse) on small entities. Alternatives 4, 5 and 6 would have greater short-term adverse effects but result in more beneficial long-term effects; Alternative 5 is predicted to provide the greatest benefit to small entities over time by reducing government regulatory constraints and allowing market-driven solutions. However, rights-based management would be more likely to eliminate some small entities from the groundfish fishery and the industry becomes more consolidated. Alternative 6 would impose substantial constraint on fishing locations (due to marine reserves), and those changes would be more permanent.

<u>Objective 17</u>. Consider the importance of groundfish resources to fishing communities, provide for the sustained participation of fishing communities, and minimize adverse economic impacts on fishing communities to the extent practicable.

The impacts of all the alternatives on communities are evaluated in Section 4.4. Adverse impacts on West Coast fishing communities continue to occur under *status quo* management. Alternatives 2 and 3 are most similar to the current bycatch mitigation and management programs and will thus have the least effect (both beneficial and adverse) on fishing communities. Alternatives 4, 5 and 6 would have greater short-term adverse effects but result in more beneficial long-term effects; Alternative 5 is predicted to provide the greatest benefit to communities over time by reducing government regulatory constraints and allowing market-driven solutions. However, rights-based management would be more likely to redistribute benefits among fishing communities; this could result in some communities losing their reliance on groundfishing. Small, isolated communities with less fishing infrastructure or higher cost structure would be the most likely impacted. Establishment of community quotas under Alternatives 5 or 6 could mitigate these effects at the cost of overall economic efficiency. Alternative 6 would impose substantial constraint on fishing locations (due to marine reserves), and those changes would be more permanent. Fishing communities near marine reserves would bear the heaviest impacts of them due to increased travel costs.

Objective 18. Promote the safety of human life at sea.

Smaller vessels may be the least mobile and may be at greater risk in severe weather conditions. Those vessels are most affected by current MPAs (Alternatives 1-4), in that they may have to travel further offshore to reach open fishing areas. Alternative 5 provides the option of reducing the use of MPAs, as bycatch and overfishing concerns would be addressed through the quota program. Alternative 6 would establish no-take marine reserves that would tend to increase the risk for those vessels home ported nearby. The rights-based management established by Alternatives 5 and 6 would tend to reduce safety risks by allowing vessels more choice of fishing conditions.

5.2 Consistency with Magnuson-Stevens Act National Standards

5.2 Consistency with Magnuson-Stevens Act National Standards

An FMP or plan amendment and any pursuant regulations must be consistent with ten national standards contained in the Magnuson-Stevens Act (§301). These are:

National Standard 1

National Standard 1 states that conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.

The program alternatives would all reflect harvest rates below the overfishing thresholds and include precautionary reductions to rebuild overfished stocks and other stocks that, while not overfished, are at a biomass below the level necessary to produce MSY. Alternatives 4, 5 and 6 would require modifications to the Observer Program, Alternative 4 to speed up data compilation for inseason application, and Alternatives 5 and 6 to expand coverage to all limited entry vessels. These latter alternatives would thus more accurately measure total groundfish catch and reduce the likelihood any overfishing would occur (or go unnoticed).

National Standard 2

National Standard 2 states that conservation and management measures shall be based on the best scientific information available.

Each of the program alternatives would be expected to rely on the best scientific information available. However, those alternatives that would expand the extent of monitoring would improve the amount and quality of information. Alternative 4 would require increased observer coverage to verify catch and bycatch (groundfish discard) rates inseason. Alternatives 5 and 6 would require 100% monitoring of the commercial limited entry fisheries and expand monitoring of other fisheries, thereby resulting in the greatest improvements.

National Standard 3

National Standard 3 states that, to the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

Under the no action alternative (Alternative 1), groundfish are managed through a combination of individual and multispecies units. These units are managed throughout the region covered by the FMP. However, any stock is not necessarily in the same condition over its range, due to environmental, ecological and fishery-related influences. In some cases, the current bycatch mitigation program uses the best scientific information available to address different conditions or species distributions. This approach is carried forward into all the alternatives.

National Standard 4

National Standard 4 states that conservation and management measures shall not discriminate between residents of different states. If it becomes necessary to allocate or assign fishing privileges among various United States fishers, such allocation shall be (A) fair and equitable to all such fishers; (B) reasonably calculated to promote conservation; and (C) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.

None of the alternatives would discriminate between residents of different states. Under all the program alternatives, management measures would continue to be developed through the Council process, which facilitates substantial participation by state representatives. Generally, state proposals are brought forward when action alternatives are crafted and integrated to the degree practicable. Alternatives 4, 5 and 6 would allocate specific shares or privileges to individuals or corporations with the specific intent to promote conservation through individual accountability for catch and bycatch. When allocating such shares, the Council and NMFS would need to ensure consistency with this National Standard.

National Standard 5

National Standard 5 states that conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose.

Current and previous bycatch mitigation measures in the groundfish fishery have not been designed specifically for the purpose of efficient utilization. To the contrary, many have been intended to reduce efficiency in order to prevent overfishing and achieving other management objectives. Alternative 2 would improve efficiency by further reducing the number of commercial trawl participants, resulting in larger average individual vessel catch levels. Alternative 3 would tend to increase harvest efficiency by increasing the size of trip limits, but would result in less efficient use of processing capacity. Alternative 4 would promote efficient harvest of healthy stocks while placing more stringent limits on catches of overfished groundfish stocks. Alternative 5 would promote efficiency above all the other alternatives by establishing a rights-based, market-driven program and relaxing restrictions that contribute to inefficiency. Alternative 6 would achieve some of the advantages of a rights-based program but would continue the use of bycatch mitigation tools that tend to reduce efficiency.

Lower OY levels and other restrictions are likely to result in further fleet capacity reduction as fishing becomes economically unviable for more vessels. There is broad consensus that capacity reduction in some sectors is needed to rationalize fisheries. A capacity reduction (buyback) program for the limited entry groundfish trawl fleet has been approved, resulting in retirement of an estimated 92 permits and vessels while compensating owners of retired vessels.

National Standard 6

National Standard 6 states that conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources and catches.

Under the current bycatch mitigation program (Alternative 1), management measures reflect differences in catch, and in particular bycatch of overfished species, among different fisheries. Alternatives 1, 2 and 3 would continue the traditional approach of calculating and predicting trip limits to address such variations and contingencies. Alternative 4 is a step towards allowing individual fishers to address some of these variations and contingencies by establishing individual catch limits for overfished species and increasing trip limits for healthier stocks, contingent on individual vessel monitoring. Alternative 6 further assigns individual opportunity, responsibility and accountability; through individual catch quotas, vessels would have the means to modify their activities to address the full range of harvest opportunities. Alternative 6 would continue to apply bycatch mitigation tools that would restrict the ability to account for variations among, and contingencies in, fisheries, fishery resources and catches.

The Council and NMFS have worked with the States of Washington, Oregon and California to manage non-groundfish fisheries to minimize bycatch of overfished groundfish species. None of the proposed program alternatives would modify that approach.

National Standard 7

National Standard 7 states that conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

The current groundfish management program has become extremely complicated for all involved fishery participants, management entities, and interested public. This is due in large part to the programmatic decision to minimize reliance on inseason monitoring of fishery catch, relying instead on monitoring retention levels. Alternatives 1, 2 and 3 continue this program approach. Alternative 4 would increase reliance on catch monitoring and the use of real-time catch data during the season, rather than post-season. This would come at increased costs to individual vessels, NMFS, or both. Alternatives 5 and 6 would establish 100% monitoring of all commercial limited entry vessels and other commercial fishing vessels. Monitoring programs that emphasize the use of fishery observers and implementation of a vessel monitoring system increase management costs but are necessary for effective management. Alternative 5 would emphasize more intensive and extensive fishery observation, reducing the need for other bycatch mitigation measures related to overfished groundfish stocks. Alternative 6 would tend to increase duplication by retaining much of the current bycatch mitigation program , increasing the level of monitoring, and closing large areas to reduce the potential for observed and unobserved bycatch.

National Standard 8

National Standard 8 states that conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

Generally, there are tradeoffs between allowing fishers and communities to access healthy, harvestable stocks and minimizing catch of overfished stocks. The alternatives address these tradeoffs differently. Alternatives 1, 2, 3 and (to a lesser extent) 4 would continue the approach of assessing and resolving these tradeoffs through the Council public process on an ongoing basis. Under Alternative 5, the Council and NMFS would establish the basic policies, procedures and parameters of an Individual Quota (IQ) program and thereafter allow market forces to determine sustained participation of fishing communities. This approach has both advantages and risks. The risk is that communities that may be less well-suited for groundfish fishing may see their participation reduced. Under the other alternatives, political intervention through the Council process could forestall such changes. However, that would undoubtedly be at the cost of some other objectives, such as efficiency, fairness, or overall management stability.

National Standard 9

National Standard 9 states that conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

Each of the programmatic alternatives directly addresses this National Standard. Alternatives 1, 2, 3 and, to a lesser extent, 4 would do this from a “command and control” approach. Alternative 6 also would continue this approach, increasing the emphasis on reducing bycatch and bycatch mortality to levels approaching zero. Alternative 5 (and to a lesser degree Alternative 4) would replace “command and control” with individual accountability, setting bycatch mortality limits for every commercial limited entry vessel. Alternative 4 would fall between Alternatives 1-3 and Alternative 5. Alternative 6 would likely result in the greatest reduction in bycatch and bycatch mortality at the highest cost to the nation (i.e., costs to fishers and public management costs).

National Standard 10

National Standard 10 states that conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

Alternatives 1, 2, 3, and 4 would continue reliance on MPAs (RCAs/GCAs) as a primary bycatch mitigation tool, which could affect safety if more vessels elect to fish seaward of the closed areas and are more exposed to bad weather conditions. Implementation of a vessel monitoring system capable of sending distress calls would mitigate this safety issue. Alternative 5 would eliminate the "race for fish" and allow vessels to choose to operate during the best weather conditions. Also, by reducing reliance on area closures and gear restrictions, vessels would likely find fishing opportunities nearer shore than the current RCA seaward boundaries. Alternative 4, if individual vessel catch limits were not included, would tend to accelerate the race for fish as vessels would attempt to maximize there catches before their sector limit is reached.

6.0 Other Federal Laws

6.0 Other Federal Laws and Executive Orders

In addition to being prepared in accordance with the requirements of the *MAGNUSON-STEVENS ACT* and *NEPA*, this document also addresses requirements of other applicable federal laws and Executive Orders (EOs). These laws and orders are described here and their applicability to this action assessed.

6.1 Other Federal Laws

Coastal Zone Management Act

6.1.1 Coastal Zone Management Act

Section 307(c)(1) of the federal Coastal Zone Management Act (*CZMA*) of 1972 requires all federal activities that directly affect the coastal zone be consistent with approved state coastal zone management programs to the maximum extent practicable. Any alternative adopted by the Council would be implemented in a manner that is consistent to the maximum extent practicable with the enforceable policies of the approved coastal zone management programs of Washington, Oregon, and California. The relationship of the groundfish FMP with the CZMA is discussed in Section 11.7.3 of the groundfish FMP. The groundfish FMP has been found to be consistent with the Washington, Oregon, and California coastal zone management programs.

Under the CZMA, each state develops its own coastal zone management program which is then submitted for federal approval. This has resulted in programs which vary widely from one state to the next. None of the alternatives under consideration is expected to affect any state's coastal management program.

Endangered Species Act

6.1.2 Endangered Species Act

NMFS issued *BIOLOGICAL OPINIONS* (BOs) under the ESA on August 10, 1990, November 26, 1991, August 28, 1992, September 27, 1993, May 14, 1996, and December 15, 1999 pertaining to the effects of the groundfish fishery on chinook salmon (Puget Sound, Snake River spring/summer, Snake River fall, upper Columbia River spring, lower Columbia River, upper Willamette River, Sacramento River winter, Central Valley spring, California coastal), coho salmon (Central California coastal, southern Oregon/northern California coastal), chum salmon (Hood Canal summer, Columbia River), sockeye salmon (Snake River, Ozette Lake), and steelhead (upper, middle and lower Columbia River, Snake River Basin, upper Willamette River, central California coast, California Central Valley, south-central California, northern California, southern California). During the 2000 Pacific whiting season, the whiting fisheries exceeded the chinook bycatch amount specified in the Pacific whiting fishery BO (December 15, 1999) incidental take statement estimate of 11,000 fish, by approximately 500 fish. In the 2001 whiting season, however, the whiting fishery's chinook bycatch was about 7,000 fish, which approximates the long-term average. After reviewing data from, and management of, the 2000 and 2001 whiting fisheries (including industry bycatch minimization measures), the status of the affected listed chinook, environmental baseline information, and the incidental take statement from the 1999 whiting BO, NMFS determined in a letter dated April 25, 2002 that a re-initiation of the 1999 whiting BO was not required. NMFS has concluded that implementation of the FMP for the Pacific Coast groundfish fishery is not expected to jeopardize the continued existence of any endangered or threatened species under the jurisdiction of NMFS, or result in the destruction or adverse modification of critical habitat.

Marine Mammal Protection Act

6.1.3 Marine Mammal Protection Act

The MMPA of 1972 is the principle federal legislation that guides marine mammal species protection and conservation policy in the United States. Under the MMPA, NMFS is responsible for the management and conservation of 153 stocks of whales, dolphins, porpoise, as well as seals, sea lions, and fur seals; while the U.S. Fish and Wildlife Service is responsible for walrus, sea otters, and the West Indian manatee. Off the West Coast, the Steller sea lion (*Eumetopias jubatus*) Eastern stock, Guadalupe fur seal (*Arctocephalus townsendi*), and Southern sea otter (*Enhydra lutris*) California stock are listed as threatened under the ESA and the sperm whale (*Physeter macrocephalus*) Washington, Oregon, and California stock, humpback whale (*Megaptera novaeangliae*) Washington, Oregon, and California - Mexico Stock, blue whale (*Balaenoptera musculus*) Eastern north Pacific stock, and Fin whale (*Balaenoptera physalus*) Washington, Oregon, and California stock are listed as depleted under the MMPA. Any species listed as endangered or threatened under the ESA is automatically considered depleted under the MMPA.

The West Coast groundfish fisheries are considered a Category

III fishery, indicating a remote likelihood of or no known serious injuries or mortalities to marine mammals, in the annual list of fisheries published in the Federal Register. Based on its Category III status, the incidental take of marine mammals in the West Coast groundfish fisheries does not significantly impact marine mammal stocks. None of the programmatic alternatives would be expected to increase impacts on any marine mammal stock (see Section 4.3.3.3).

Migratory Bird Treaty Act

6.1.4 Migratory Bird Treaty Act

The *MIGRATORY BIRD TREATY ACT* of 1918 (*MBTA*) was designed to end the commercial trade of migratory birds and their feathers that, by the early years of the 20th century, had diminished populations of many native bird species. The MBTA states that it is unlawful to take, kill, or possess migratory birds and their parts (including eggs, nests, and feathers) and is a shared agreement between the United States, Canada, Japan, Mexico, and Russia to protect a common migratory bird resource. The MBTA prohibits the directed take of seabirds, but the incidental take of seabirds does occur. As discussed in Section 4.3.3.2, the proposed alternatives are unlikely to affect the incidental take of seabirds protected by the MBTA. Alternatives 5 and 6, by requiring expanded monitoring of all commercial groundfishing activities, would improve the quality and quantity of information about seabirds in the region and interactions between fishing operations and those birds.

Paperwork Reduction Act

6.1.5 Paperwork Reduction Act

The Magnuson-Stevens Act requires collection of information on bycatch and bycatch mortality, and each of the program alternatives addresses this requirement to some degree. Alternatives 1, 2 and 3 would not lead to any new or expanded collection-of-information requirements subject to the Paperwork Reduction Act (PRA). Alternatives 5 and 6 would require all commercial limited entry vessels to carry an observer onboard whenever they fish for groundfish, and perhaps also when targeting certain nongroundfish species. Alternative 4 could require all commercial groundfish vessels to complete logbooks, expanding the currently coastwide trawl logbook requirement and making it a federal rather than state program. No regulations subject to the PRA are proposed in conjunction with this EIS; if and when proposed, the appropriate PRA analysis would be completed at that time.

Regulatory Flexibility Act

6.1.6 Regulatory Flexibility Act

[NOTE: THE REGULATORY FLEXIBILITY ACT (RFA) DOES NOT APPLY TO A PROGRAMMATIC EIS (SUCH AS THIS ONE) THAT WILL NOT IMMEDIATELY RESULT IN REGULATIONS. HOWEVER, MUCH OF THE INFORMATION AND ANALYSIS IN CHAPTER 4 OF THIS EIS WOULD BE RELEVANT TO AN RFA ANALYSIS. WHEN THE COUNCIL AND NMFS DEVELOP REGULATIONS TO IMPLEMENT THE ADOPTED PROGRAM ALTERNATIVE(S), THE RFA WILL APPLY. THE FOLLOWING DISCUSSION IS PROVIDED FOR GENERAL INFORMATION ONLY.]

The purpose of the RFA is to relieve small businesses, small organizations, and small governmental entities of burdensome regulations and record-keeping requirements. Major goals of the RFA are; (1) to increase agency awareness and understanding of the impact of their regulations on small business, (2) to require agencies communicate and explain their findings to the public, and (3) to encourage agencies to use flexibility and to provide regulatory relief to small entities. The RFA emphasizes predicting impacts on small entities as a group distinct from other entities and the consideration of alternatives that may minimize the impacts while still achieving the stated objective of the action. An IRFA is conducted unless it is determined that an action will not have a “significant economic impact on a substantial number of small entities.” The RFA requires that an IRFA include elements that are similar to those required by EO 12866 and NEPA.

6.2 Executive Orders

Executive Order 12866-Regulatory Impact Review

6.2.1 EO 12866 (Regulatory Impact Review)

[NOTE: EO 12866 DOES NOT APPLY TO A PROGRAMMATIC EIS (SUCH AS THIS ONE) THAT WILL NOT IMMEDIATELY RESULT IN REGULATIONS. HOWEVER, MUCH OF THE INFORMATION AND ANALYSIS IN CHAPTER 4 OF THIS DRAFT PEIS WOULD BE RELEVANT TO AN EO 12866 ANALYSIS. WHEN THE COUNCIL AND NMFS DEVELOP REGULATIONS TO IMPLEMENT THE ADOPTED PROGRAM ALTERNATIVE(S), A REGULATORY IMPACT REVIEW MAY BE REQUIRED. THE FOLLOWING DISCUSSION IS PROVIDED FOR GENERAL INFORMATION ONLY.]

EO 12866, Regulatory Planning and Review (September 30, 1993), established guidelines for promulgating new regulations and reviewing existing regulations. The EO covers a variety of regulatory policy considerations and establishes procedural requirements for analysis of the benefits and costs of regulatory actions. Section 1 of the EO deals with the regulatory philosophy and principles that are to guide agency development of regulations. It stresses that in deciding whether and how to regulate, agencies should assess all of the costs and benefits across all regulatory alternatives. Based on this analysis, NMFS should choose those approaches that maximize net benefits to society, unless a statute requires another regulatory approach.

Environmental Justice

6.2.2 EO 12898 Environmental Justice

EO 12898 obligates federal agencies to identify and address "disproportionately high adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations in the United States" as part of any overall environmental impact analysis associated with an action. NOAA guidance, NAO 216-6, at §7.02, states that "consideration of EO 12898 should be specifically included in the NEPA documentation for decision making purposes." Agencies should also encourage public participation—especially by affected communities—during scoping as part of a broader strategy to address environmental justice issues.

The environmental justice analysis must first identify minority and low-income groups that live in the project area and may be affected by the action. Typically, census data are used to document the occurrence and distribution of these groups.

Agencies should be cognizant of distinct cultural, social, economic, or occupational factors that could amplify the adverse effects of the proposed action. (For example, if a particular kind of fish is an important dietary component, fishery management actions affecting the availability or price of that fish could have a disproportionate effect.) In the case of Indian tribes, pertinent treaty or other special rights should be considered. Once communities have been identified and characterized, and potential adverse impacts of the alternatives are identified, the analysis must determine whether these impacts are disproportionate. Because of the context in which environmental justice is developed, health effects are usually considered, and three factors may be used in an evaluation: whether the effects are deemed significant, as the term is employed by NEPA; whether the rate or risk of exposure to the effect appreciably exceeds the rate for the general population or some other comparison group; and whether the group in question may be affected by cumulative or multiple sources of exposure. If disproportionately high adverse effects are identified, mitigation measures should be proposed. Community input into appropriate mitigation is encouraged.

This EIS describes tribal communities affected by the program alternatives and impacts to those and other communities (see Sections 3.4.4 and 3.4.6). Available demographic data show that coastal counties where these communities are located are variable in terms of social indicators like income, employment, and race and ethnic composition. However, equivalent data specific to the groups directly affected by the alternatives are not available. Treaty tribes harvesting West Coast groundfish are part of the Council's decision-making process on groundfish management issues, and tribes with treaty rights to salmon, groundfish, or halibut have a seat on the Council.

The alternative programs under consideration could affect groundfish allocations or harvest levels that could in turn disproportionately impact low income and minority populations.

Federalism

6.2.3 EO 13132 (Federalism)

EO 13132 enumerates eight "fundamental federalism principles." The first of these principles states "Federalism is rooted in the belief that issues that are not national in scope or significance are most appropriately addressed by the level of government closest to the people." In this spirit, the EO directs agencies to consider the implications of policies that may limit the scope of or preempt states' legal authority. Preemptive action having such "federalism implications" is subject to a consultation process with the states; such actions should not create unfunded mandates for the states; and any final rule published must be accompanied by a "federalism summary impact statement." The Council process offers many opportunities for states (through their agencies, Council appointees, consultations, and meetings) to participate in the formulation of management measures. This process encourages states to institute complementary measures to manage fisheries under their jurisdiction that may affect federally-managed stocks.

None of the program alternatives under consideration has federalism implications subject to EO 13132.

Consultation and Coordination With Indian Tribal Governments

6.2.4 **EO 13175** (Consultation and Coordination With Indian Tribal Governments)

EO 13175 is intended to ensure regular and meaningful consultation and collaboration with tribal officials in the development of federal policies that have tribal implications, to strengthen the United States government-to-government relationships with Indian tribes, and to reduce the imposition of unfunded mandates upon Indian tribes.

The Secretary recognizes the sovereign status and co-manager role of Indian tribes over shared federal and tribal fishery resources. At Section 302(b)(5), the Magnuson-Stevens Act reserves a seat on the Council for a representative of an Indian tribe with federally-recognized fishing rights from California, Oregon, Washington, or Idaho.

The U.S. government formally recognizes the four Washington coastal tribes (Makah, Quileute, Hoh, and Quinault) have treaty rights to fish for groundfish. In general terms, the quantification of those rights is 50% of the harvestable surplus of groundfish available in the tribes' *U AND A FISHING AREAS* (described at 50 CFR 660.324). Each of the treaty tribes has the discretion to administer their fisheries and to establish their own policies to achieve program objectives.

Accordingly, the alternatives have been developed in consultation with the affected tribe(s). The Council and NMFS will consult with the affected tribes before making final decisions on the preferred alternative.

Responsibilities of Federal Agencies to Protect Migratory Birds

6.2.5 EO 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds)

EO 13186 supplements the *MBTA* (above) by requiring federal agencies to work with the U.S. Fish and Wildlife Service to develop memoranda of agreement to conserve migratory birds. NMFS is scheduled to implement its memorandum of understanding by January 2003. The protocols developed by this consultation will guide agency regulatory actions and policy decisions in order to address this conservation goal. The EO also directs agencies to evaluate the effects of their actions on migratory birds in environmental documents prepared pursuant to the NEPA.

Section 4.3.32 evaluates impacts to seabirds and concludes that the none of the program alternatives would significantly impact seabirds.

7.0 Preparers and Contributors

Jim Glock	NMFS, Northwest Regional Office, Portland, Oregon
Jim Golden	Consultant, Toledo, Oregon
Cyreis Schmitt	Oregon Department of Fish and Wildlife, Newport, Oregon
Dr. Doyle Hanan	Consultant, Rancho Santa Fe, California
Dr. William Lenarz,	Consultant, Marin County, California
Jamie Goen	NMFS, Northwest Regional Office, Seattle, Washington
Carrie Nordeen	NMFS, Northwest Regional Office, Seattle, Washington
Elizabeth R. Mitchell	NOAA General Council, Seattle
Yvonne deReynier	NMFS, Northwest Regional Office, Seattle, Washington
Dr. Christopher ("Kit") Dahl	Pacific Fishery Management Council, Portland, Oregon
Marcus Hartley	Northern Economics, Inc, Anchorage, Alaska
Dr. Donald Schug	Northern Economics, Inc
Dr. Katherine Wellman	Northern Economics, Inc, Seattle, Washington
Tamer Kirac	Northern Economics, Inc, Bellingham, Washington
Kelly Porteen	Northern Economics, Inc, Bellingham, Washington
Fran Recht	Pacific States Marine Fisheries Commission, Depoe Bay, Oregon
Nicolle Hill	NMFS, Northwest Regional Office, Seattle, Washington
Dr. Stephen Freese	NMFS, Northwest Regional Office, Seattle, Washington
Steve Copps	NMFS, Northwest Regional Office, Seattle, Washington

Executive Summary:	Glock
Chapter 1:	Glock; Mitchell; de Reynier
(past management, scoping)	Goen; Dahl
Chapter 2:	Glock; PFMC ad hoc Groundfish EIS Oversight Committee; Golden
Chapter 3:	Glock
(Groundfish):	Golden; Lenarz; Glock
(Non-groundfish):	Schmitt
(Marine mammals, turtles):	Hanan
(Sea birds):	Nordeen
(Social and Economic):	Hartley, Schug, Wellman, Kirac, Porteen
Chapter 4 (Environmental Impacts)	
(Gear descriptions, impacts)	Recht; Glock; Golden
(Groundfish):	Golden; Lenarz; Glock
(Non-groundfish):	Schmitt
(Marine mammals, turtles):	Hanan
(Sea birds):	Nordeen
(Social and Economic):	Hartley, Schug, Wellman, Kirac, Porteen
Chapter 5 (Consistency):	Glock
Chapter 6 (Other federal law):	Glock

Appendix A:	Schmitt, Lenarz, Golden
Appendix B:	NWFSC Groundfish Observer Program
Appendix C:	Hartley
Appendix D: (Tribal Fisheries)	Hill

Contributor Bios

Mr. Jim Glock served as the project manager for this Draft EIS. From 1987-2000, he was the Groundfish Staff Officer for the Pacific Fishery Management Council and also dealt with the Northern Anchovy FMP (replaced by the Coastal Pelagic Species FMP) and Pacific halibut management. From 1980-1987, Mr. Glock served as a Fishery Management Plan Coordinator for the North Pacific Fishery Management Council FMPs for salmon, king crab, and Bering Sea/Aleutian Islands groundfish. He also helped prepare a draft FMP for Bering Sea herring.

Dr. Doyle Hanan retired from the California Department of Fish and Game where he served as a senior supervising biologist over nearshore sport fisheries, pelagic fisheries, and marine mammals. He serves on two standing committees to advise the Secretary of Commerce on marine mammals in the Pacific Ocean and reduction of marine mammal, seabird, and turtle/ fisheries interactions. He served as co-chair of the PFMC's Coastal Pelagic Species (CPS) FMP development team and chair of the CPS management team. He has worked extensively on marine mammal, seabird and turtle populations, as well as many California recreational and commercial fisheries.

Mr. Jim Golden retired from the Oregon Department of Fish and Wildlife (ODFW) as Acting Director of the ODFW Marine Resources Program after 25 years of service. His experience with ODFW included all technical aspects of groundfish research in support of stock assessments, including age determination of rockfish and flatfish, at-sea research and surveys, submersible and scuba diving investigations, computer programming, analysis, and modeling. He has contributed to formal stock assessments using a variety of contemporary fisheries models (VPA, catch-at-age-analysis, and stock synthesis). He has served as chair of a Council Stock Assessment Review (STAR) panel and also participated on the PFMC's Strategic Plan Implementation Committee.

Ms. Cyreis Schmitt is a marine fish biologist who currently works for the Oregon Deptartment of Fish and Wildlife in Newport, Oregon. Ms. Schmitt has worked for the International Pacific Halibut Commission, the Washington Department of Fish and Wildlife, and NMFS Northwest Fisheries Science Center (NWFSC). At the NWFSC, she spearheaded preparation of the Council's first groundfish EFH plan amendment, including preparation of the extensive EFH appendix. Also while at NWFSC, she managed the FRAM Division in Newport, Oregon and oversaw the groundfish stock assessment preparation and review process.

Mr. Marcus Hartley was the lead economist for NOAA Fisheries' Draft PSEIS for the Groundfish Fisheries of Alaska (2003) and EIS for the Pelagic Fisheries of the Western Pacific Region (2001). As Vice President of Northern Economics, Inc (Anchorage, AK), he has managed and contributed to many other fisheries projects, including sector and regional profiles of the groundfish fisheries of Alaska, an assessment of processing limits and excessive shares under the American Fisheries Act, license limitation programs for crab and groundfish, and other fishery management issues. As (former) senior economist at the North Pacific Fishery Management Council, Mr. Hartley was deeply involved with high profile allocation issues confronting North Pacific fisheries. These issues included individual fishing quotas for sablefish and halibut, a vessel moratorium and license limitation programs for crab and groundfish, inshore and offshore pollock processing allocations, allocation of Pacific cod among gear groups, and commercial and recreational allocation of halibut.

Dr. Donald Schug is a social scientist who has written reports and peer-reviewed publications covering a broad range of fisheries-related topics in the United States and abroad. He has worked extensively in the Pacific islands, including Polynesia (Hawaii and American Samoa), Micronesia (Kiribati) and Melanesia (Papua New Guinea). He has conducted analyses of the economic and social aspects of fisheries and fisheries management at the community, national, and international levels. As staff social scientist for the Western Pacific Fishery Management Council, Dr. Schug prepared assessments of the social and economic impacts of federal management regimes for pelagic, bottomfish, crustacean, and precious coral fisheries in the U.S.-affiliated Pacific islands. In his current position as a Socioeconomic Analyst with Northern Economics, Inc., Dr. Schug has been closely involved in the development of the economic assessment for the Alaska Groundfish Fisheries Draft Programmatic Supplemental EIS.

Mr. Tamer Kirac is an economist with 20 years of experience in regional socio-economic analysis and project management. He has worked as technical staff and as a project manager preparing regional economic plans and natural resource development and investment impacts studies. He has assisted numerous small and large communities to conduct economic base analysis and to develop strategic plans, incorporating primary and secondary sources of information derived from public meetings, surveys, and public and proprietary information sources.

Ms. Kelly Porteen is a recent graduate of the University of Wyoming with a Masters of Science in Economics, with an emphasis in natural resource economics.

Dr. Katharine (Trina) Wellman specializes in environmental and natural resource economics as applied to marine resource management (including commercial and recreational fisheries) and public policy development and implementation. She has conducted research in the areas of fisheries and wetland restoration, water quality management and enhancement, habitat protection and conservation, and coastal hazards mitigation. Dr. Wellman's dissertation research looked at consumer choices of seafood products taking into account quality as a choice variable. She has been involved in the conceptual design of individual transferable quota schemes for the U.S. fishing industry and analyzed the cost structure of the early Northwest Pacific factory trawler fleet.

Glossary and Acronyms

A

ABC Acceptable biological catch – see below

Abyss The deepest part of the ocean.

Acceptable biological catch (**ABC**) Refers to the allowable catch for a species or species group, based on its estimated abundance. The ABC is used to set the upper limit of the annual total allowable catch and is calculated by applying the estimated or proxy harvest rate that produces maximum sustainable yield to the estimated exploitable stock biomass.

Allocation Distribution of the opportunity to fish among user groups or individuals. The share a user group gets in sometimes based on historic harvest amounts.

Alternatives Different combinations of management objectives and measures to reduce bycatch to the extent practicable, reduce bycatch mortality, and to assess the amount and type of bycatch in the fishery. This EIS analyzes the environmental impacts of each alternative.

Angler A person catching fish or shellfish with no intent to sell. This includes people releasing the catch.

Annuli Annual variations in the pattern of growth rings on fish scales or otoliths.

Anthropogenic Refers to the effects of human activities.

B

B_0 Unfished biomass; the estimated size of a fish stock at equilibrium in the absence of fishing.

$B_{25\%}$ 25% of unfished biomass. This is the Council's threshold for declaring a stock overfished or the Minimum Stock Size Threshold.

$B_{40\%}$ 40% of unfished biomass. This is the Council's threshold for declaring a stock rebuilt or the size of the stock estimated to produce MSY. This is also referred to as B_{MSY}.

Bag limit The number and/or size of a species that a person can legally take in a day or trip. This may or may not be the same as a possession limit.

Baleen A specialized plate of horny material used by some species of whales (Mysticetes) to filter-feed.

Barotrauma Physical trauma or injury to a fish due to pressure change. When a fish is rapidly brought from deep water to the surface, the drop in pressure can cause a variety of physical problems, such as severe expansion of the swim bladder and gas bubbles in the blood.

Bathymetry The measurement of ocean depth.

Bathypelagic Zone The zone of the ocean that extends from 1,000m to 4,000m below the surface of the ocean.

Benthic Refers to organisms that live on or in the ocean floor.

Benthic Invertebrate	An animal, such as a mollusk, with no spinal column that lives on the ocean floor.
Best available science	The term "best available science" comes from the second National Standard listed in the Magnuson-Stevens Act and is the informational standard mandated for decision-making.
Bight	A name for the water body found abutting a large indentation in the coast. A bight is less enclosed than a bay.
Bimodal distribution	Indicating two length groups within which individuals are most abundant, possibly with other less abundant length groups around them.
Bioaccumulation	The build-up over time of substances (like metals) that cannot be excreted by an organism.
Biodiversity	The variation in life on Earth reflected at all levels, from various ecosystems and species, to the genetic variation within a species. See also ecosystem diversity, species diversity, genetic diversity.
Biological Opinion	A scientific assessment issued by the National Marine Fisheries Service, as required by the Endangered Species Act for listed species.
Biomass	The total weight of a group (or stock) of fish in a given area. The term biomass means total biomass (age one and above) unless stated otherwise.
BiOp	Biological opinion (see above)
Biota	Refers to any and all living organisms and the ecosystems in which they exist.
Biotic Factor	A living component of the environment which arises from and affects living organisms (distinct from physical factors). For example, the interaction between predators and prey is a biotic interaction.
Bioturbation	Disturbance of soft sediments by the movements and feeding activities of infauna (animals that live just beneath the surface of the sea bed).
B_{MSY}	The biomass that produces the maximum sustainable yield.
BO	Biological opinion (see above)
BRD	Bycatch reduction device (finfish excluders, etc.). These are devices incorporated in fishing gears designed to reduce the take of non-target species.
Bycatch	In this EIS, the term bycatch is used to mean discarded catch of any living marine resource, plus any unobserved mortality that results from a direct encounter with fishing gear. This is slightly broader than the Magnuson-Stevens Act definition, which is limited to fish and therefore does not include marine mammals and seabirds. These species are included in this EIS definition because they are protected by other laws and must also be avoided by fishers. Bycatch includes economic discards, regulatory discards, and fish donated to a charitable organization.
Bycatch model	A model used to calculate amounts of overfished species and other groundfish expected to be caught under various trip limits or certain combinations of measures. Strictly speaking, it calculates expected catch rather than bycatch.

C

CA	California

CalCOFI California Cooperative Fishery Investigation

California Rockfish Conservation Area The **CRCA** is defined as, (1) Ocean waters 20 fm to 250 fm between Cape Mendocino and Point Reyes and 20fm to 150 fm between Point Reyes and the U.S.-Mexico Border, and (2) the Cowcod Conservation Areas. The purpose of the CRCA is to regulate all gear types that have a potentially significant affect on rebuilding of overfished rockfish species south of Cape Mendocino.

California Bight The region of concave coastline off Southern California between the headland at Point Conception and the U.S./Mexican border, and encompassing various islands, shallow banks, basins and troughs extending from the coast roughly 200 km offshore.

Catch The total number or poundage of fish captured from an area over some period of time. This includes fish that are caught but released or discarded instead of being landed. The catch may take place in an area different from where the fish are landed. Note that catch, harvest, and landings are different terms with different definitions.

Catcher/processor A factory-trawl vessel that participates in the Pacific whiting fishery. This type of vessel catches fish and processes fish. Also, a sector of the whiting fishery.

Catch per unit of effort (CPUE) The quantity of fish caught (in number or in weight) with one standard Unit of fishing effort; (e.g., number of fish taken per 1,000 hooks per day or weight of fish, in tons, taken per hour of trawling). CPUE is often considered an index of fish biomass (or abundance). Sometimes referred to as catch rate. CPUE may be used as a measure of economic efficiency of fishing as well as an index of fish abundance.

CCA Cowcod Conservation Area(s) - see below

CDFG California Department of Fish and Game

CEQ Council on Environmental Quality

Cetaceans Marine mammals of the order *Cetacea*. Includes whales, dolphins and porpoises.

CFR Code of Federal Regulations – see below

cm centimeter

Coastal pelagic species (**CPS**) Coastal pelagic species are schooling fish, not associated with the ocean bottom, that migrate in coastal waters. They are usually planktivorous (plankton-eating) and the main forage of higher level predators such as tuna, salmon, most groundfish, and man. Examples are herring, squid, anchovy, sardine, and mackerel.

Coastal Zone Management Act (**CZMA**) An act of federal law with the main objective to encourage and assist states in developing coastal zone management programs, to coordinate state activities, and to safeguard regional and national interests in the coastal zone.

Code of Federal Regulations (**CFR**) A codification of the regulations published in the *Federal Register* by the executive departments and agencies of the federal government. The CFR is divided into 50 titles that represent broad areas subject to federal regulation. Title 50 contains wildlife and fisheries regulations.

Codend The end of a trawl net. Fish are eventually swept into the codend as the net is dragged along.

Cohort	In a stock, a group of fish generated during the same spawning season and born during the same time period. Also, in cold and temperate areas, where fish are long-lived, a cohort corresponds usually to fish born during the same year (a year class).
Commercial fishing	Fishing in which the fish harvested, either whole or in part, are intended to enter commerce through sale, barter, or trade.
Commercial Fishery	A term related to the whole process of catching and marketing fish and shellfish for sale. It refers to and includes fisheries resources, fishermen, and related businesses directly or indirectly involved in harvesting, processing, or sales.
Community	An ecological unit composed of the various populations of micro-organisms, plants, and animals that inhabit a particular area.
Continental Shelf	The submerged continental land mass, not usually deeper than about 100 fathoms (200 m). The shelf may extend from a few miles off the coastline to several hundred miles.
Continental Slope	The steeply sloping seabed that connects the continental shelf and continental rise.
Convergence	The contact at the sea surface between two water masses converging, one plunging below the other.
Co-occurring stocks	Stocks of different fish that swim or school near one another, and may be caught together.
Coriolis effect	The deflection of air or water bodies, relative to the solid earth beneath, as a result of the earth's eastward rotation.
Council	Pacific Fishery Management Council
Cowcod Conservation Area(s)	(**CCA**) Two areas located in the Southern California Bight southwest of Santa Monica to the California-Mexico border that encompass roughly 4,300 nm^2 of habitat where the highest densities of cowcod occur. These areas are closed to bottom fishing in order to rebuild the cowcod stock to B_{MSY}.
CPFV	Commercial passenger fishing vessel or charterboat operating in waters off California
CPS	Coastal pelagic species - see above
CPUE	Catch per unit of effort - see above
CRCA	California Rockfish Conservation Area - see above
Cumulative limit	The total allowable amount of a species or species group, by weight, that a vessel may take and retain, possess, or land during a period of time. Fishers may take as many landings of a species or species complex as they like as long as they do not exceed the cumulative limit that applies to the vessel or permit during the designated period.
CZMA	Coastal Zone Management Act - see above

D

Decomposer	An organism which gains energy by breaking down the final remains of living things. Predominantly bacteria and fungi, decomposers are important in freeing the last of minerals and nutrients from organic matter and recycling them back into the food web. See also decomposition; compare detrivore.
Decomposition	The biochemical process where biological materials are broken down into smaller particles and eventually into basic chemical compounds and elements. See also decomposer.
DEIS	Draft environmental impact statement
Demersal	Fish and animals living in close relation with the sea floor.
Density dependence	The degree to which recruitment changes as spawning biomass changes. Typically we assume that a Beverton-Holt form is appropriate and that the level of density-dependence is such that the recruitment only declines by 10% when the spawning biomass declines by 50%.
Derby fishery	A fishery of a few days' or weeks' duration during which fishers compete to take as much catch as they can before the fishery closes. Also called a race for fish.
Detritus	Dead organic matter of plant or animal. See also detrivore.
Detrivore	An organism that feeds on large bits of dead and decaying organic matter (detritus). What detrivores leave behind is used by decomposers. Crabs and seabirds are examples of detrivores. Compare decomposer; see also detritus.
Diatom	One-celled phytoplankton with an external skeleton of silica.
Discards	Fish that are not retained at sea, regardless of reason. Synonymous with the Magnuson-Stevens Act definition of "bycatch."
Dispersal	The spreading of individuals throughout suitable habitat within or outside the population range. In a more restricted sense, the movement of young animals away from their point of origin to locations where they will live at maturity
Distribution	(1) A species distribution is the spatial pattern of its population or populations over its geographic range. (2) A population age distribution is the proportions of individuals in various age classes. (3) Within a population, individuals may be distributed evenly, randomly, or in groups throughout suitable habitat.
Diversity	Genetic variations that allow a population to use a wider array of environments, protect against short-term spatial or temporal changes in the environment and survive long-term environmental changes.
Downwelling	The process whereby prevailing seasonal winds create surface currents that cause surface water to sink, bringing nutrient-poor ocean surface water into the area.
DTS complex	Dover sole/thornyhead/trawl-caught sablefish complex

E

EA	Environmental assessment – see below
EC	Enforcement Consultants – see below
Ecological Niche	The role a plant or animal plays in its community. The niche of an organism is defined by what it eats, its predators, salt tolerances, light requirements etc. Two species are not stabile if they both live in the same habitat if they occupy identical niches.

Ecology	The study of the physical and biological interactions between an organism and its natural environment.
Economic discard	The portion of bycatch that is not caused by regulations but is related to other factors. Fish discarded because they are too small to be sold, or the wrong species, are considered to be economic discards. Broadly defined it can mean all discard that is not related to regulations.
Ecosystem	A community of plants, animals and other organisms that are linked by energy and nutrient flows and that interact with each other and with the physical environment.
Ecosystem Diversity	The diversity of biological communities and their physical environment. Diversity is determined by the species composition, physical structure and processes within an ecosystem. This is the highest level of biodiversity. See also biodiversity; compare species diversity, genetic diversity.
EEZ	Exclusive Economic Zone – see below
Effects	Impacts; anticipated results of an action. Effects include ecological, aesthetic, historic, cultural, economic, social, or health. They may be beneficial or detrimental. An EIS describes and analyzes anticipated effects of the alternatives. (Also, see impacts below)
Effort	The amount of time and fishing power used to harvest fish. Fishing power includes gear size, boat size, and horsepower.
EFH	Essential fish habitat – see below
EFP	Exempted fishing permit – see below
EIS	Environmental impact statement – see below
Ekman circulation	Movement of surface water at an angle from the wind, as a result of the Coriolis effect.
El Niño Southern Oscillation	(**ENSO** or **El Niño**) Abnormally warm ocean climate conditions, which in some years affect the Eastern coast of Latin America (centered on Peru) often around Christmas time. The anomaly is accompanied by dramatic changes in species abundance and distribution, higher local rainfall and flooding, massive deaths of fish and their predators. Many other climatic anomalies around the world are attributed to consequences of El Niño. See also La Niña, below.
Endangered Species Act	(**ESA**) An act of federal law that provides for the conservation of endangered and threatened species of fish, wildlife, and plants. When preparing fishery management plans, councils are required to consult with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service to determine whether the fishing under a fishery management plan is likely to jeopardize the continued existence of an ESA-listed species, or to result in harm to its critical habitat.
Endemic	An animal or plant species that naturally occurs in an area.
Energetics	The study of the flow and transformation of energy, as between trophic levels.
Enforcement Consultants	A Council committee that provides advice on enforcement of fishery regulations.
ENSO	El Niño Southern Oscillation – see above

Environment	All of the physical, chemical, and biological factors in the area where a plant or animal lives.
Environmental assessment	(**EA**) As part of the National Environmental Policy Act (NEPA) process, an EA is a concise public document that provides evidence and analysis for determining whether to prepare an Environmental Impact Statement (EIS) or a Finding of No Significant Impact.
Environmental impact statement	(**EIS**) As part of the National Environmental Policy Act (NEPA) process, an EIS is an analysis of the expected impacts resulting from the implementation of a fisheries management or development plan (or some other proposed action) on the environment. EISs are required for all fishery management plans as well as significant amendments to existing plans. The purpose of an EIS is to ensure that the fishery management plan gives appropriate consideration to environmental values in order to prevent harm to the environment.
EO	Executive Order
EO 12866	A Federal executive order that, among other things, requires agencies to assess the economic costs and benefits of all regulatory proposals and complete a Regulatory Impact Analysis (RIA) that describes the costs and benefits of the proposed rule and alternative approaches, and justifies the chosen approach. See RIR.
Epibenthic	A term for organisms that live attached to the bottom.
Epipelagic zone	The upper region of the sea from the surface to about 200-300 meters depth. see Photic Zone
Epiphyte	A plant that grows on another plant.
ESA	Endangered Species Act
Essential fish habitat	(**EFH**) Those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity.
Estuary	A semi-enclosed body of water with an open connection to the sea. Typically there is a mixing of sea and fresh water, and the influx of nutrients from both sources results in high productivity.
Evolutionarily Significant Unit	**(ESU)** a population segment equivalent to the "Distinct Population" referred to in the Endangered Species Act
Exclusive Economic Zone	(**EEZ**) All waters from the seaward boundary of coastal states out to 200 nautical miles. This was formally called the Fishery Conservation Zone (FCZ).
Exempted fishing permit	(**EFP**) A permit issued by National Marine Fisheries Service that allows exemptions from some federal fishing regulations in order to study the effectiveness, bycatch rate, or other aspects of an experimental fishing gear or technique.
Exploitable biomass	The biomass that is available to a unit of fishing effort. Defined as the sum of the population biomass at age (calculated as the mean within the fishing year) multiplied by the age-specific availability to the fishery. Exploitable biomass is equivalent to the catch biomass divided by the instantaneous fishing mortality rate.
External Costs	Costs that are not paid by the responsible individual, but rather transferred to others. For example, a polluter may not pay for dirty air.

Extirpation	Situation when something is no longer present.
Exvessel	Refers to activities that occur when a commercial fishing boat lands or unloads a catch. For example, the price received by a captain for the catch is an exvessel price.

F

F	The rate of fishing mortality. – see below
F_{MSY}	is the fishing mortality rate that maximizes catch biomass in the long term.
F_{OF}	is the rate of fishing mortality defined as overfishing.
$F_{x\%}$	is the rate of fishing mortality that will reduce female spawning biomass per recruit to x% of its unfished level. $F_{100\%}$ is zero, and $F_{40\%}$ is believed to be a reasonable proxy for F_{MSY} for some species.
Factory-trawl	A type of vessel that catches fish with trawl gear and processes the fish onboard. Sometimes called catcher/processor. In the West Coast groundfish fishery, the only target species for this type of vessel is Pacific whiting.
Fathom	Six feet.
FEAM	Fishery economic assessment model – see below
Fecundity	The potential of an organism to produce offspring, measured in the number of gametes produced.
Federal Register	The *Federal Register* is the official daily publication for Rules, Proposed Rules, and Notices of Federal agencies and organizations, as well as Executive Orders and other Presidential documents. Fisheries regulations are not considered final until they are published in the *Federal Register*.
Finfish	A common term to define fish as separate from shellfish.
Fish	Fish means finfish, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds.
Fish stock	A population of a species of fish from which catches are taken in a fishery. Use of the term "fish stock" usually implies that the particular population is more or less isolated from other stocks of the same species, and hence self-sustaining.
Fisheries Management Measure	Any specified limitation that restricts or conditions the fishing privilege. Some measures are specified as codified regulations; other measures may have the same effect but are technically not regulations. Measures established by a State apply to all fishers operating in waters of that State, and also to residents of that State, regardless of where they fish.
Fisheries observers	Trained professionals who monitor and record catch data from commercial fishing vessels and processing facilities. Observers collect data on species composition of the catch, weights, and disposition of fish caught, seabird sightings and marine mammal interactions. Observers also collect biological data such as sexed fish lengths, weights and aging structures.
Fishery	All the activities involved in catching a species of fish or group of species.
Fishery-dependent	Describes data about fish resources collected by sampling commercial and recreational catches.

Fishery-independent	Describes data about fish resources collected by methods other than sampling commercial and recreational catches. An example of such a method is a NMFS trawl survey.
Fishery economic assessment model	(**FEAM**) uses historical landings data, information on industry cost and margin structure (vessels and processors), and income multipliers generated by IMPLAN to produce estimates of "regionalized" local income impact after deducting for leakage of payments to non-residents and to non-local suppliers, wholesalers, and manufacturers.
Fishery management plan	(**FMP**) A plan, and its amendments, that contains measures for conserving and managing specific fisheries and fish stocks.
Fishing	The catching, taking, or harvesting of fish; the attempted catching, taking, or harvesting of fish; any other activity that can reasonably be expected to result in the catching, taking, or harvesting of fish; any operations at sea in support of, or in preparation for, any of these activities. This term does not include any activity by a vessel conducting authorized scientific research.
Fishing community	A community which is substantially dependent on or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs. Includes fishing vessel owners, fishing families, operators, crew, recreational fishers, fish processors, gear suppliers, and others in the community who depend on fishing.
Fishing mortality	(**F**) - A measurement of the rate of removal of fish from a population by fishing. Fishing mortality can be reported as either annual or instantaneous. Annual mortality is the percentage of fish dying in one year; instantaneous is that percentage of fish dying at any one time. The acceptable rates of fishing mortality may vary from species to species.
Fishing year	January 1 through December 31.
Fixed gear	Fishing gear that is stationary after it is deployed (unlike trawl or troll gear which is moving when it is actively fishing). Within the context of the limited entry fleet, "fixed gear" means longline and fishpot (trap) gear. Within the context of the entire groundfish fishery, fixed gear includes longline, fishpot, and any other gear that is anchored at least at one end.
fm	fathom (6 feet)
FMP	fishery management plan – see above
Food Chain	A linear sequence of organisms that exist on successive trophic levels within a natural community, through which energy is transferred by feeding. Primary producers capture energy from the environment (through photo- or chemo-synthesis) and form the base of the food chain. Energy is then passed to primary consumers (herbivores) and on to secondary and tertiary consumers (carnivores and top carnivores) (e.g. phytoplankton -> zooplankton -> herring -> salmon -> killer whales). Once they die, these organisms are in turn consumed and their energy transferred to detrivores and decomposers.
Food Web	A non-linear network of feeding between organisms that includes many food chains, and hence multiple organisms on each trophic level. A network describing the feeding interactions of the species in an area.
Forage	Fish such as herring, smelt and krill that are eaten by seabirds, mammals, and larger fish.
FWS	U.S. Fish and Wildlife Service

G

Gamete A reproductive cell.

GAP Groundfish Advisory Subpanel – see below

GF Groundfish

Ghost fishing Situation when abandoned fishing gear continues to catch organisms

Gillnet A curtain-like net suspended in the water with mesh openings large enough to permit only the heads of the fish to pass through, ensnaring them around the gills when they attempt to escape

GMT Groundfish Management Team – see below

Green mud Greenish sand deposits in which glauconite is abundant.

Groundfish A species or group of fish that lives most of its life on or near the sea bottom.

Groundfish Advisory Subpanel (**GAP**) The Council established the GAP to obtain the input of the people most affected by, or interested in, the management of the groundfish fishery. This advisory body is made up of representatives with recreational, trawl, fixed gear, open access, tribal, environmental, and processor interests. Their advice is solicited when preparing fishery management plans, reviewing plans before sending them to the Secretary, and reviewing the effectiveness of plans once they are in operation.

Groundfish Management Team (**GMT**) Groundfish management plans are prepared by the Council's GMT, which consists of scientists and managers with specific technical knowledge of the groundfish fishery.

H

Habitat The immediate space where an animal or plant lives and has food, water and protection. Habitat loss, which includes the destruction, degradation, or fragmentation of habitats, is the primary cause of decreasing biodiversity.

Harvest The total number or poundage of fish caught and kept from an area over a period of time. Note that landings, catch and harvest are different.

Harvest specifications The detailed regulations that make up management measures – for example, trawl footrope size, depth limits, net mesh size, etc.

Harvest guideline(s) A numerical harvest level that is a general objective, but not a quota. Attainment of a harvest guideline does not require a management response, but it does prompt review of the fishery.

HG Harvest guideline(s) – see above

High seas All waters beyond the EEZ of the United States and beyond any foreign nation's EEZ, to the extent that such sea is recognized by the United States.

Highly migratory species (**HMS**) In the Council context, highly migratory species in the Pacific Ocean include species managed under the HMS Fishery Management Plan: tunas, sharks, billfish/swordfish, and dorado or dolphinfish.

HMS Highly migratory species – see above

Hydrography The arrangement and movement of bodies of water, such as currents and water masses.

I

IFQ	Individual fishing quota. See below.
Impact	Effect; a change from current conditions, or a change that would result from an action. Impacts may be direct, indirect and cumulative, and may be significant or not significant. An EIS provides an analysis of expected impacts that would result from the alternatives being considered and identifies those considered to be significant.
IMPLAN	(IMpact Analysis for PLANning) a regional economic impact model
Incidental catch or incidental species	Groundfish and other fish species caught when fishing for the primary purpose of catching a different species or species group. Incidental catch that is released, returned to the sea, discarded at sea, or retained and donated to a charitable food organization is considered a type of bycatch.
Individual fishing quota	(IFQ) A Federal permit under a limited access system to harvest a quantity of fish, expressed by a unit or units representing a percentage of the total allowable catch of a fishery that may be received or held for exclusive use by a person (individual fisherman or vessel owner).
Individual transferable (or tradeable) quota	(ITQ) A type of IFQ allocated to individual fishermen or vessel owners and which can be sold, leased, exchanged, etc, to others.
Initial Regulatory Flexibility Analysis	(IRFA) An analysis required by the Regulatory Flexibility Act (see RFA).
INPFC	International North Pacific Fishery Commission – see below
International Pacific Halibut Commission	(IPHC) A Commission responsible for studying halibut stocks and the halibut fishery. The IPHC makes proposals to the U.S. and Canada concerning the regulation of the halibut fishery.
International North Pacific Fishery Commission	(INPFC) was a tri-lateral commission of Canada, Japan and the U.S. established in 1952, to coordinate marine fisheries research and address scientific and management issues of mutual concern. Although the Commission was dissolved in 1993, the statistical areas defined by the are still commonly used in marine fisheries management.
Intertidal	Between the high and low tide marks and periodically exposed to air.
IPHC	International Pacific Halibut Commission – see above
IRFA	Initial regulatory flexibility analysis – see above
Isotherm	An imaginary line passing through points on the earth's surface having the same mean temperature.
ITQ	Individual transferable (or tradeable) quota – see above

JKL

Jetty	A rocky structure constructed from land into the sea to protect shore-based property.
Jig	An artificial lure made to simulate live bait. It is usually made with a lead head cast on a single hook and is heavier than most other lures.
Juvenile	A young fish or animal that has not reached sexual maturity.

Keystone species A species that maintains community structure through its feeding activities, and without which large changes would occur in the community.

Keystone predator The dominant predator or the top predator that has a major influence on community structure. For example, sea otters are a keystone predator in kelp beds. Sea otters eat urchins that feed on kelp which house a huge diversity of other organisms. If sea otter populations are lowered in an area the kelp beds are generally reduced and urchin barrens appear.

Knot A unit of speed equal to one nautical mile per hour (approximately 51 centimeters per second).

La Niña An episode of strong trade winds and unusually low sea surface temperature in the central and eastern tropical Pacific. The opposite of El Niño (see above).

Landing, or landed catch The number or poundage of fish unloaded at a dock by commercial fishermen or brought to shore by recreational fishermen for personal use. Landings are reported at the points at which fish are brought to shore. Note that landings, catch, and harvest define different things.

LE Limited entry – see below

Limited entry fishery A fishery for which a fixed number of permits have been issued in order to limit participation.

Limiting factor A factor primarily responsible for determining the growth and/or reproduction of an organism or a population. The limiting factor may be a physical factor (such as temperature or light), a chemical factor (such as a particular nutrient), or a biological factor (such as a competing species). The limiting factor may differ at different times and places.

Littoral zone The intertidal zone.

Local depletion Local depletion occurs when localized catches take more fish than can be replaced either locally or through fish migrating into the catch area. Natural causes can also result in local depletion. Local depletion can occur apart from the status of the overall stock, and can be greater than decreases in the entire stock.

Logbook A document or form for recording specified information about commercial fishing activities. Logbooks must be maintained by groundfish trawl vessels in accordance with state fishing regulations. Some logbook information is used in stock assessments, inseason monitoring, and predicting landings.

Long-term potential yield The maximum long-term average yield that can be achieved through conscientious stewardship, by controlling the proportion of the population removed by harvesting by regulating fishing effort or total catch levels.

M

m meters

M Instantaneous natural mortality rate (as opposed to F, fishing mortality rate) or the rate of mortality not related to fishing.

Magnuson-Stevens Fishery Conservation and Management Act The **MFCMA**, sometimes called the "**Magnuson-Stevens Act**," established the 200 nm fishery conservation zone (EEZ), the regional fishery management council system, and the process and mandates for regulating marine fisheries in the EEZ.

Marine Mammal Protection Act	The **MMPA** prohibits the harvest or harassment of marine mammals, although permits for incidental take of marine mammals while commercial fishing may be issued subject to regulation.
Marine Recreational Fisheries Statistical Survey	(**MRFSS**) A national survey conducted by National Marine Fisheries Service to estimate the impact of recreational fishing on marine resources.
Maturity	The age at which an animal is physically capable of reproduction
Maximum sustainable yield	(**MSY**) An estimate of the largest average annual catch or yield that can be continuously taken over a long period from a stock under prevailing ecological and environmental conditions . Since MSY is a long-term average, it need not be specified annually, but may be reassessed periodically based on the best scientific information available.
Maximum fishing mortality threshold	(**MFMT**) A threshold fishing mortality rate identified in the National Standard Guidelines above which constitutes overfishing.
MBTA	Migratory Bird Treaty Act
Mean	The sum of the data divided by the number of pieces of data; the average.
Median	Within a data set, the median is the number that divides the bottom 50% of the data from the top 50%.
Mesopelagic Zone	A somewhat arbitrary depth zone in offshore or oceanic waters, usually below 600 feet and above 3,000 (200-1,000 meters or 100-500 fathoms). It is bordered by the photic zone above and darkness below.
MFMT	Maximum fishing mortality threshold – see above
MHHW	Mean higher high water level or the average of the highest of two daily high tides in the Pacific Ocean (i.e., high tide line)
Minimum stock size threshold	(**MSST**) A threshold biomass used to determine if a stock is overfished. The proxy for groundfish MSST is $B_{25\%}$.
Mitigation	includes avoiding the impact altogether, minimizing impacts, rectifying the impact by repairing the environment, reducing or eliminating the impact over time, or compensating for the impact in other ways.
MLMA	California Marine Life Management Act.
MLPA	California Marine Life Protection Act.
mm	Millimeter
MMPA	Marine Mammal Protection Act – see above
Morphology	The physical characteristics of an individual.
Mothership	A vessel that does not catch groundfish but processes fish (whiting) delivered by other vessels. A sector of the whiting fishery.
MOU	Memorandum of Understanding
MPA	Marine protected area; an area in which some human activities are restricted.
MRFSS	Marine Recreational Fisheries Statistics Survey – see above

MRPZ	Marine resources protection zone
MSA	Magnuson-Stevens Fishery Conservation and Management Act (also known as Magnuson-Stevens Act) – see above
MSST	Minimum stock size threshold; sometimes called the overfishing threshold – see above
MSY	Maximum sustainable yield (see above).
mt	Metric ton = 2,204.62 pounds.

N

NAO	NOAA Administrative Order
National Standards Guidelines	(**NSG**) Guidelines issued by National Marine Fisheries Service to provide comprehensive guidance for the development of fishery management plans and amendments that comply with the national standards of the Magnuson-Stevens Act. These guidelines are found in Title 50, Code of Federal Regulations, part 600.
National Environmental Policy Act	(**NEPA**) Passed by Congress in 1969, NEPA requires Federal agencies to consider the environment when making decisions regarding their programs. Section 102(2)(C) requires Federal agencies to prepare an Environmental Impact Statement (EIS) before taking major Federal actions that may significantly affect the quality of the human environment. The EIS includes: the environmental impact of the proposed action, any adverse environmental effects which cannot be avoided should the proposed action be implemented, alternatives to the proposed action, the relationship between local short-term uses of the environment and long-term productivity, and any irreversible commitments of resources which would be involved in the proposed action should it be implemented.
National Marine Fisheries Service	(**NMFS** or **NOAA Fisheries**) A division of the U.S. Department of Commerce, National Ocean and Atmospheric Administration (NOAA). NMFS is responsible for conservation and management of offshore fisheries (and inland salmon). The NMFS Regional Director is a voting member of the Council.
NE	Northeast
Nearshore	"Nearshore" is defined (by the California Nearshore Fishery Management Plan) as the area from the high-tide line offshore to a depth of 120 ft (20 fm).
Nekton	Pelagic organisms that are free-swimming and so whose movements are independent of the tides, currents and waves. Such animals include fish, whales, squid, crabs and shrimps.
NEPA	National Environmental Policy Act – see above
Neritic	Inhabiting coastal waters primarily over the continental shelf, generally over bottom depths equal to or less than 183 meters (100 fm) deep.
Neuston	The distribution of nekton is limited by temperature and nutrient supply and decreases with decreasing depth. Compare benthic, plankton surface water.
NMFS	National Marine Fisheries Service – see above
NOAA	National Oceanic and Atmospheric Administration

NOI	Notice of Intent
North Pacific Fishery Management Council	(**NPFMC**) The regional fishery management council established by the Magnuson-Stevens Act to develop management plans and recommendations for managing marine fish stocks in the EEZ off Alaska.
NPDES	National Pollutant Discharge Elimination System
NS	Nearshore – see above
NSG	National Standards Guidelines – see above

O

OA	Open access. See below.
Oceanic	Inhabiting the open sea, ranging beyond the continental and insular shelves, beyond the neritic zone.
ODFW	Oregon Department of Fish and Wildlife
OMB	Office of Management and Budget
Open-access fishery	The segment of the groundfish fishery or any other fishery for which entry is not controlled by a limited entry permitting program.
Optimum yield	(**OY**) The amount of fish that will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems. The groundfish FMP specifies a default harvest control rule (the **"40-10" rule**) that reduces the OY of any stock found to be less than its estimated MSY stock size. If a stock is overfished, the OY provides for rebuilding to its MSY stock size, consistent with the analysis prepared for its rebuilding plan.
OSP	Oregon State Police
OSP	Optimum sustainable population (in reference to marine mammals)
Otolith	"Ear bone" of a fish; calcareous concretions in the inner ear of a fish, functioning as organs of hearing and balance. They often show seasonal or annual "rings" that can be counted to determine age.
Otter trawl	A cone-shaped net that is dragged along the sea bottom. Its mouth is kept open by floats, weights and by two otter boards which shear outward as the net is towed.
Over-capitalization	In a fishing fleet, this means more money has been invested in boats than the fishery can support. It can also refer to the ability of fishermen to increase effort without increasing the number of boats. If no new boats are added to a fishery, but each boat doubles its fishing power by carrying twice as much gear or using new technology (sonar, GPS, etc.), the new effort can have the same effect as doubling the number of boats. Other commercial fishery sectors can also become overcapitalized.

Overfished Any stock or stock complex whose size is sufficiently small that a change in management practices is required to achieve an appropriate level and rate of rebuilding. The term generally describes any stock or stock complex determined to be below its overfished/rebuilding threshold. The default proxy is generally 25% of its estimated unfished biomass; however, other scientifically valid values are also authorized.

Overfishing Fishing at a rate or level that jeopardizes the capacity of a stock or stock complex to produce MSY on a continuing basis. More specifically, overfishing is defined as exceeding a maximum allowable fishing mortality rate (or the MFMT). For any groundfish stock or stock complex, the maximum allowable mortality rate will be set at a level not to exceed the corresponding MSY rate (F_{MSY}) or its proxy (e.g., $F_{35\%}$).

Oviparous Producing eggs that hatch outside the female's body.

Ovoviviparous Pertaining to an animal that incubates eggs inside the mother until they hatch.

OY Optimum yield – see above

P

PacFIN Pacific Coast Fisheries Information Network. A database managed by the Pacific States Marine Fisheries Commission that provides commercial fishery information for Washington, Oregon, and California.

Pacific decadal oscillation (PDO) A long-term, El Niño-like pattern of Pacific climate variability. Two main characteristics distinguish PDO from El Niño/Southern Oscillation (ENSO): first, 20th century PDO "events" persisted for 20-to-30 years, while typical ENSO events persisted for 6 to 18 months; second, the climatic "fingerprints" of the PDO are most visible in the North Pacific/North American sector, while secondary signatures exist in the tropics - the opposite is true for ENSO.

Pacific Fishery Management Council (PFMC) The regional fishery management council established by the Magnuson-Stevens Act to develop management plans and recommendations for managing marine fish stocks (including salmon) in the EEZ off the coasts of Washington, Oregon and California.

Pacific States Marine Fisheries Commission (PSMFC) Authorized by Congress in 1947, the PSMFC is one of three interstate commissions dedicated to resolving fishery issues. Representing California, Oregon, Washington, Idaho, and Alaska, the PSMFC does not have regulatory or management authority; rather it serves as a forum for discussion, and works for coastwide consensus to state and federal authorities. PSMFC addresses issues that fall outside state or regional management council jurisdiction.

Parturition Birth

Patchy distribution A condition in which organisms occur in aggregations.

PBR Potential biological removal – see below

PDO Pacific decadal oscillation – see above

Pelagic Inhabiting the water column as opposed to being associated with the sea floor; generally occurring anywhere from the surface to 1000 meters (547 fm). See also epipelagic and mesopelagic.

Pelagic	Refers to the plants and animals that live in the water column or in the open waters of the ocean rather than the ocean floor (see benthic). Life is found throughout the pelagic zone, however is more concentrated at shallower depths. Pelagic organisms can be further divided into the plankton and nekton. Compare benthic. (epipelagic: living in the upper or photic layer between 0 and 200 meters; mesopelagic: living between 200 and 1000 meters).
Permit stacking	The registration of more than one limited entry permit for a single vessel, where a vessel is allowed additional catch for each additional permit registered for use with the vessel.
PFMC	Pacific Fishery Management Council – see above
Photic zone	The surface layer of the ocean that is penetrated by sunlight. The photic zone is the layer of the ocean that has been explored the most as it is relatively easy to access with conventional diving equipment. Light can penetrate down to approximately 200m which marks the end of the photic zone. Also referred to as the Sunlight Zone or the Epipelagic Zone.
Phytoplankton	Microscopic planktonic plants. Examples include diatoms and dinoflagellates
Pinniped	A member of the order of marine mammals that includes the seals, sea lions, and walruses, all having four swimming flippers.
Piscivorous	An organism that eats fish.
Planktivorous	An organism that feeds on planktonic organisms.
Plankton	Pelagic organisms that float through the water column, not attached to any substrate and unable to move against the currents and tides. Plankton can be further divided into phytoplankton and zooplankton, meroplankton and holoplankton. Compare nekton.
POP	Pacific ocean perch
Population	All individuals of the same species living in a certain area during a given time. Environmental barriers may divide the population into local breeding units with restricted interbreeding between the localized units.
Potential biological removal	(PBR) The maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population.
PRA	Paperwork Reduction Act
Preferred alternative	The alternative that is identified as preferred by the authors of an environmental impact statement or environmental assessment. It is identified to indicate which alternative is likely to be selected, thereby helping the public focus its comments.
Processing	The preparation or packaging of fish to render it suitable for human consumption, retail sale, industrial uses, or long-term storage, including but not limited to cooking, canning, smoking, salting, drying, filleting, freezing, or rendering into meal or oil, but not heading and gutting unless additional preparation is done.

Production Gross primary production is the amount of light energy converted to chemical energy in the form of organic compounds by autotrophs like algae. The amount left after respiration is net primary production and is usually expressed as biomass or calories/unit area/unit time. Net production for carnivores and herbivores is based on the same concept, except that chemical energy from food, not light, is used and partially stored for life processes. Efficiency of energy transfers between trophic levels ranges from 10-65% (depending on the organism and trophic level). Organisms at high trophic levels have only a fraction of the energy available to them that was stored in plant biomass. After respiration loss, net production goes into growth and reproduction, and some is passed to the next trophic level.

Productivity The rate at which a given quantity of organic material is produced by organisms.

Prohibited species Species that may not be retained, and that should not be captured or harmed. Prohibited species identified in the groundfish FMP include Pacific halibut, salmonids, and Dungeness crab.

Prohibited species catch or cap (PSC) A PSC limit is a specified limit on the amount of the species that may be caught or killed.

PSMFC Pacific States Marine Fisheries Commission – see above.

Q-R

Q The selectivity of fishing gear or the ratio of fish caught by the gear to those actually present.

QSM Quota species monitoring is a PacFIN database that monitors the cumulative landings of species managed either with individual OYs or OYs prescribed for a species complex (grouping of species in a single management unit). The GMT uses quota species monitoring to develop inseason groundfish fishery management recommendations to attempt to attain, but not exceed, prescribed OYs.

Quota A specified numerical harvest objective, the attainment (or expected attainment) of which causes closure of the fishery for that species or species group.

R/S Recruits per spawner.

R Recruits or recruitment**.** This is the estimated production of new members to a population as measured at a specific life stage.

R_0 Level of unfished recruitment.

Race for fish (see Derby Fishery).

Rebuilding Implementing management measures that increase a fish stock to its target size.

Rebuilding Plan When abundance of a groundfish stock is found to have declined to 25% or less of the size it was before any fishing (or to some other early stock size), it must be rebuilt to its MSY stock size, which is typically about 40% of the unfished size. A rebuilding plan calculates how long it will take to rebuild the stock and the methods and management measures that will be used.

RecFin Recreational Fishery Information Network. A database managed by the Pacific States Marine Fisheries Commission that provides recreational fishery information for Washington, Oregon, and California.

Recreational Fishing Recreational fishing means fishing for sport or pleasure, but not for sale.

Recruit — An individual fish that has moved into a certain class, such as the spawning class or fishing-size class.

Recruitment — (1) Entry of new fish into a population, whether by reproduction or immigration; (2) Addition of new individuals to the fished component of a stock (because they have acquired the size, age, or location that makes them part of it.)

Regime shift — A long-term change in marine ecosystems and/or in biological production resulting from a change in the physical environment. – see also PDO above

Regulatory discard — The portion of bycatch that results from fishers complying with the regulations.

Regulatory Flexibility Analysis (or Act) — (**RFA**) Anytime an agency publishes a notice of proposed rule making, an RFA is required. It describes the action, why it is necessary, the objectives and legal basis for the action, a description of who will be impacted by the action, and a description of the projected reporting, record-keeping, and other compliance requirements of the proposed rule. The types of entities subject to the rule, and the professional skills required to prepare the report or record, must also be described.

Reproductive potential — The number of offspring possible for a female of a given species to produce if she lives to the average age.

Restricted species catch quota — (**RSQ**) A specified catch limit of an overfished stock that applies to an individual vessel or limited entry permit holder. A type of individual quota or cap.

RFA — Regulatory Flexibility Analysis, or Regulatory Flexibility Act – see below

RIR — Regulatory Impact Review – See Regulatory Flexibility Analysis.

Roller trawl — A trawl net equipped with rollers that enable the net to go over rocky areas without snagging.

Rulemaking — The process of developing Federal regulations which occurs in several steps, including publishing proposed rules in the *Federal Register*, accepting comments on the proposed rule, and publishing the final rule. An "advanced notice of proposed rulemaking" is published when dealing with especially important or controversial rules.

S

SAFE — Stock assessment and fishery evaluation. See below.

Salmonid — A member of the Salmonidae family of fishes.

Scientific and Statistical Committee — (**SSC**) An advisory committee of the PFMC made up of scientists and economists. The Magnuson-Stevens Act requires that each council maintain an SSC to assist in gathering and analyzing statistical, biological, ecological, economic, social, and other scientific information that is relevant to the development of fishery management plans.

Scoping — An early and open process for determining the scope (range) of issues to be addressed and for identifying the significant issues related to a proposed action.

***Sebastes* complex** — Rockfish assemblage, including most species of the genus *Sebastes*.

Secondary Consumer — A heterotrophic, carnivorous organism that feeds on a primary consumer. Herring feeding on zooplankton are an example of a secondary consumer. See also food chain, heterotroph, primary consumer.

Secretary — The U.S. Secretary of Commerce.

Sessile	Referring to animals that are permanently attached to a substrate.
Set gillnet	A gillnet that is anchored on both ends.
Setline	Fishing gear made up of a long main line attached to which are a large number of short branch lines. At the end of each branch line is a baited hook. When catching groundfish and Pacific halibut, setlines are typically laid on the sea-floor. When catching swordfish, shark or tuna they are buoyed near the surface. Setlines can be twenty or more miles long. They are also called longlines.
Shelf	see continental shelf, above.
Shelf survey	NMFS bottom trawl surveys of the continental shelf, designed to provide information on distribution and abundance of demersal species, and other biological resource information.
Shore-based	Refers to catcher vessels that deliver Pacific whiting to processing facilities on land. This sector of the whiting fishery, as the other sectors, has a whiting allocation.
SFA	Sustainable Fisheries Act of 1996 that amended the Magnuson-Stevens Act with stricter stock conservation standards including the prescribed rules for rebuilding overfished marine fish populations.
Simple random sampling	A sampling procedure for which each possible sample is equally likely to be the one selected. A sample obtained by simple random sampling is called a simple random sample.
Slope	see continental slope, above.
Slope survey	NMFS bottom trawl surveys of the continental slope, designed to provide information on distribution and abundance of demersal species, and other biological resource information.
Southern California bight	See California Bight
Spawning biomass	The biomass of mature female fish at the beginning of the year. If the production of eggs is not proportional to body weight, then this definition is construed to be proportional to expected egg production.
Species	(1) A fundamental taxonomic group ranking after a genus. (2) A group of organisms recognized as distinct from other groups, whose members can interbreed and produce fertile offspring
Species Richness	The number of different species that exist within a given area or community. Compare species abundance.
Species diversity	A measure of both species abundance and species richness. An area that has a large number of species and many representative individuals from each species is more diverse than an area that has only a single species. See also biodiversity; compare ecosystem diversity.
Spawning Potential Ratio	**(SPR)** the number of eggs that could be produced by an average recruit in a fished stock, divided by the number of eggs that could be produced by an average recruit in an unfished stock. SPR can also be expressed as the spawning stock biomass per recruit (SSBR)
Spawning Stock Biomass	(**SSB**) the total weight of the fish in a stock that are old enough to spawn

SSBR	Spawning Stock Biomass Per Recruit - the spawning stock biomass divided by the number of recruits to the stock, or how much spawning biomass an average recruit would be expected to produce.
SSC	Scientific and Statistical Committee – see above
STAR	Stock assessment review
STAR Panel	Stock Assessment Review Panel
STAT	Stock Assessment Team
Status quo	“No action,” or the current conditions and expected conditions if no action is taken.
Stock	A grouping of fish usually based on genetic relationship, geographic distribution, and movement patterns. Stock is the practical unit of a population that is selected for management or harvesting purposes. In some casts a managed stock may include more than one species.
Stock Assessment and Fishery Evaluation (SAFE)	A SAFE document is a document prepared by the Council that provides a summary of the most recent biological condition of species in the fishery management unit, and the social and economic condition of the recreational and commercial fishing industries, including the fish processing sector. It summarizes, on a periodic basis, the best scientific information available concerning the past, present, and possible future condition of the stocks and fisheries managed in the FMP.
Stratified random sampling	A sampling method in which one (1) divides the population into subpopulations (called strata), (2) obtains from each stratum a simple random sample of size proportional to the size of the stratum, and (3) uses all of the members obtained in step 2 as the sample.
Substrate	A solid surface on which an organism lives or to which it is attached (also called substratum); or, a chemical that forms the basis of a biochemical reaction or acts as a nutrient for microorganisms.
Subtidal zone	The benthic zone extending from the low tide mark to the outer edge of the continental shelf.
Sustainable	A sustainable way of life is one in which human needs are met without diminishing the ability of other people, wild species, or future generations to survive.
SWFSC	Southwest Fisheries Science Center (NMFS)
Swim bladder	A sac inside the fish’s body by which the fish can control buoyancy
Sympatry	The common occurrence of two taxa (closely related forms) in the same geographic area.

T

TAC	Total allowable catch (this term is used for Pacific halibut and for Alaska groundfish but typically not for West Coast groundfish)
Target fishing	Fishing for the primary purpose of catching a particular species or species group (the target species).

Territorial sea	A zone extending seaward from the shore or internal waters of a nation for a distance of twelve miles (19.3 km) as defined by the United Nations Conference on the Law of the Sea (UNCLOS). The coastal state has full authority over this zone but must allow rights of innocent passage.
Thermocline	The often sharply defined boundary between surface water and deeper, cooler water. The water layer in which temperature changes most rapidly with increasing depth.
T_{MAX}	The maximum time period to rebuild an overfished stock according to National Standard Guidelines
T_{MIN}	The minimum time period to rebuild an overfished stock according to National Standard Guidelines
Total catch OY	Total catch optimum yield. The landed catch plus discard mortality.
Trammel net	An entangling net that hangs down in several curtains.
Transect	A straight line placed on the ground along which ecological measurements are taken. If an ecologist wanted to sample the diversity of intertidal organisms in the intertidal, he/she would place a number of transects perpendicular to the shore and take samples at predetermined interval lengths.
Trawl	A sturdy bag or net that can be dragged along the ocean bottom, or at various depths above the bottom, to catch fish.
Tribal	Refers to vessels owned and operated by members of the four coastal Indian Tribes in Washington that harvest groundfish. Amounts of various groundfish, including sablefish and whiting, are set aside for harvest by Tribal fishers.
Troll	To trail artificial or natural baits behind a moving boat. The bait can be made to skip along the surface or trailed below at any depth to just above the bottom.
Trophic	Concerning feeding habits, food chains, or nutrition
Trophic level	The nutritional position occupied by an organism in a food chain or food web; e.g. primary producers (plants); primary consumers (herbivores); secondary consumers (carnivores), etc.

U

U and A	Usual and accustomed
Upwelling	The process whereby prevailing seasonal winds create surface currents that allow nutrient rich cold water from the ocean depths to move into the euphotic or epipelagic zone.
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
Viviparous	Bringing forth living young, rather than being an egg-layer. Rockfish are viviparous.
VMS	Vessel monitoring system

VWXYZ

WA	Washington
Water column	The water from the surface to the bottom at a given point.

WDFW Washington Department of Fish and Wildlife

WOC Washington, Oregon and California

Year-class Refers to animals of a species population hatched or born in the same year at about the same time; also known as a cohort. Strong year classes result when there is high larval and juvenile survival; the reverse is true for weak year-classes. The effects of strong and weak year-classes on population size and structure persist for years in species with long lives. Variation in year-class strength often affects fisheries.

YOY Young-of-the-year.

Zooplankton Animal members of the plankton.